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Rights of Part Owners of Patents.

I have been asked to state what are the rights of part owners of patents (usually designated "tenants in common") as against each other.

In one important respect, viz., whether or not one part owner is obliged to share the profits arising from the exploitation of his share with the other part owners—the law is not settled. I shall refer to this matter more particularly further on. In other respects the law is well settled, and may be stated as follows:

When several persons together own a patent, and there is no contract defining or limiting the rights of each, then each part owner has the right to do with his interest all that any other or all the other part owners can do with his or their interest or interests.

Each part owner, and equally whether his proportionate interest be large or small, can make and sell the invention throughout the United States and its territories.

The other part owners cannot restrain him from doing this. The courts will not entertain a suit to prevent one part owner from working a patent to any extent through the manufacture and sale of articles embodying the invention.

The part owner can also grant licenses under the patent, and any number of them, as if he owned the entire interest, except that probably he cannot grant an exclusive license.

I do not know of any decision which has expressly held that one part owner of a patent cannot grant a valid exclusive license; but to permit him to do this would be to violate the principles which underlie the reasoning of the courts on the general question.

The other part owners cannot enjoin the licensee of the one part owner from operating under his license, nor can they compel the licensee to pay to them any part of the royalties or consideration for the license. In short, they have no cause of action against the licensee as long as he operates under his license.

But can the other part owners, who have derived no profit from their interests, compel that part owner who has derived a profit from his interest to share that profit with them?

This is doubtful. Eleven years ago Justice Bradley, of the United States Supreme Court, sitting at Circuit, said on this point:

"The exact mutual rights of co-owners of a patent have never yet been authoritatively settled. If one part owner derives a profit from the patent it would seem that he should be accountable to other part owners for their portion of such profit. And probably a bill for an account would be sustained."

We cannot speak more positively now than then upon the point. But certain probabilities are indicated in more recent decisions.

The courts of the United States and of the State of New York incline to distinguish between the profits which a part owner makes from the manufacture and sale of articles under the patent, and the profits arising from his granting of licenses. They incline to the opinion that he can keep to himself all the former profits, but must share the latter.

CARBORUNDUM CRYSTALS REDUCED ABOUT ONE-HALF.

The courts of Massachusetts incline, however, to the opinion that one part owner can keep to himself both kinds of profits.

A suit by one part owner against another for a share of the profits will, in general, be one which the United States courts will not entertain. It must be brought, as a general thing, in the State courts.

The principles above stated do not apply to patents which are owned by partnerships, for such patents are not the individual property of the partners, but are owned by the firm, as a firm. They are a part of the partnership assets.

D. WALTER BROWN.

New York, July 26.

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Carborundum.

The development of electric power at Niagara Falls has facilitated, if indeed it may not be said to have permitted, the growth of an industry there which is unique in many respects—the manufacture of an entirely new substance and product by new methods and appliances; a product, too, which possesses properties of great value to the machine constructor.

Several years ago Mr. E. G. Acheson became interested in the problem of producing by artificial means the crystalline form of carbon (which is another name for the diamond) to equal the diamond in hardness. He first produced a crystalline substance (later found to be a compound of carbon and silicon) in small quantities at a cost of nearly $10 per pound. It was found that, even at this high cost, it could be economically employed by lapidaries and by valve grinders; its hardness being nearly equal to that of the diamond, and its cost not prohibitive, when considered in comparison with the cost and efficiency of the abrading materials previously obtainable.

The earliest furnaces made to produce this material, now known as carborundum, yielded about one-quarter of a pound per day, and its use was of course very much restricted.

The heat required for fusing the materials used in making carborundum can be apparently supplied to advantage only by the electric current, and, since to make the material in large quantities requires large amounts of electrical energy supplied at a cost not prohibitive, the development of the electric power from the fall of water at Niagara, naturally enough, led to the establishment of the industry there, and during the sessions of the A. S. M. E. at that place last spring the factory was thrown open to visitors and the processes fully explained by Mr. Acheson and those associated with him; Mr. A., being now the president of the Carborundum Company, which manufactures carborundum in large quantities, making grinding wheels and other forms of grinding implements out of it in large numbers and sends them all over the world wherever grinding and polishing are done.

The raw materials for the production

of carborundum are sand, coke, sawdust and salt. The sand used, which comes from Pennsylvania, is very nearly pure silica, and together with all the other materials, except the coke, is used as it comes to the works. The coke, however, must be crushed, and afterward is screened by revolving screens into two sizes, the larger size being used in making what is known as the core for the furnace and the finer powdered coke for the mixture or charge. Salt is used because it was found to facilitate the operation of fusing, and the sawdust simply burns out of the mixture early in the "run" and leaves the mass porous, so that gases developed can pass through the mass readily, and explosions, which formerly sometimes occurred, are thus avoided.

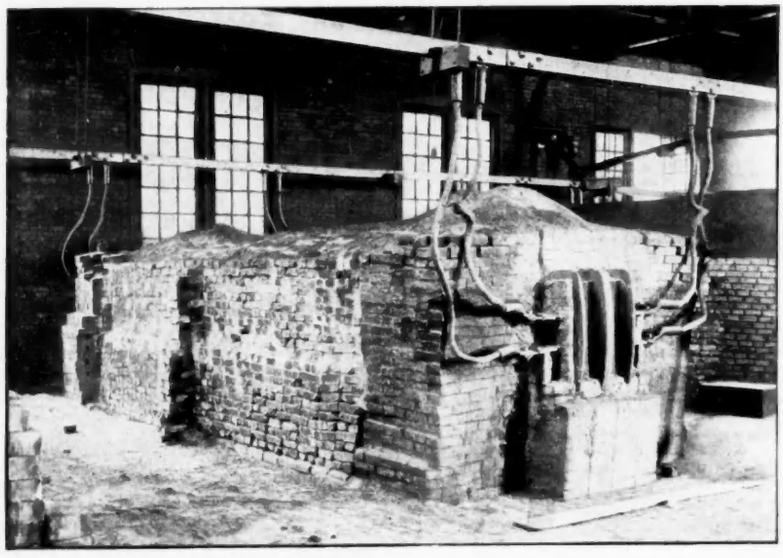

FIG. 1.—A CARBORUNDUM FURNACE BURNING.

The core, which is cylindrical in form, is composed of granulated coke; the current passes through this from end to end of the furnace, its resistance develops the heat and the mixture which surrounds the core is fused, and upon cooling crystallizes and forms carborundum. This is then crushed and screened and used either loose, as for polishing marble, etc., or, mixed with vitreous substances, made into wheels of all the familiar shapes and sizes, which are then burned in kilns, bushed and turned ready for use.

At Fig. 1 we give a view of a furnace in operation. There are at present five such furnaces in use at Niagara, their internal dimensions being about 16 feet long and 5 feet square in section. The ends are composed of brick walls 2 feet thick, and in the center of each one of these walls is a terminal consisting of sixty carbon rods 30 inches long, 3 inches diameter. The outer ends of these carbons are inclosed in a square iron frame, to which is fastened a plate drilled with sixty holes, through each one of which passes a ⅜-inch copper rod. Each rod passes into and tightly fits a hole drilled in the end of the corresponding carbon. The space between the projecting inward ends of the carbons is packed tightly with graphite, and to suitable ribs projecting from the plate, as shown in Fig. 1, the cables conveying the current are attached.

That portion of the furnace between the ends just described is not permanent, but is built up each time the furnace is charged. At the right of Fig. 1 is seen a portion of another furnace just charged and ready for the current. It will be noticed that the material is symmetrically rounded up on top, but as the heating progresses this settles, as shown in the photograph, where also the fire is seen emerging from the interstices of the intermediate or temporary brickwork.

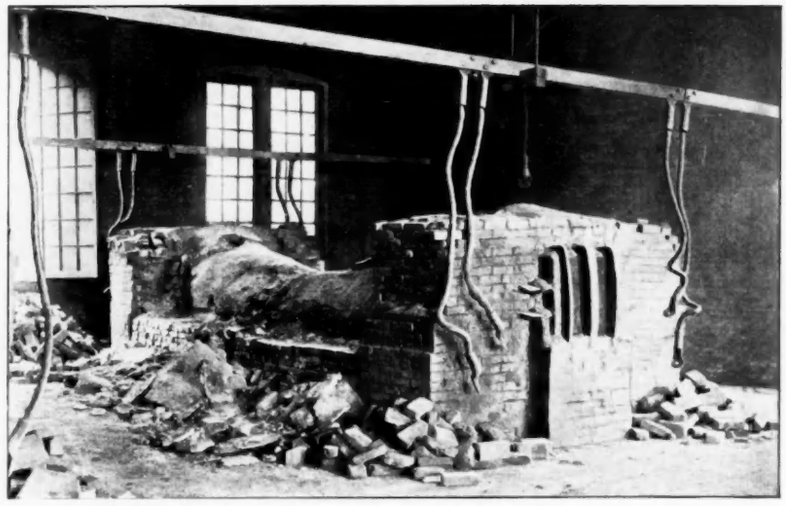

FIG. 2.—A CARBORUNDUM FURNACE AT THE END OF A RUN AND PARTLY OPENED

In arranging a furnace for a run the side walls are first built up to a hight of about 4 feet. Pieces of sheet iron are then placed at a distance of about 4 inches from the inner ends of the carbon terminals in such a way as to keep the mixture from coming in contact with them. The mixture is then thrown into the furnace until it is rather more than half full. A semi-circular trench having a radius of 10½ inches, and extending from end to end of the furnace, is then formed, the bottom of the trench being a little above the level of the bottom row of carbons. Into this trench is introduced the core, which has been carefully weighed, so that the amount required to make the core of the right size is used. One of the furnaces requires about 1,100 pounds of "new core," that is to say, core which has come directly from the bins; or about 850 pounds of "old core," or core which has previously been used in the furnace. All the core having been emptied into the trench, the top is rounded off neatly by hand, so that when finished it is a cylinder 21 inches in diameter and about 14 feet long, composed of small pieces of coke and extending from the sheet iron plates at either end of the furnace.

After this finely ground coke is packed into the spaces between the ends of the carbons and the pieces of sheet iron, after which the walls are built up to a hight of about 5 feet, the pieces of sheet iron removed and more mixture thrown in and heaped up to a hight of about 8 feet.

The furnace is then ready for the current, which is delivered at 2,200 volts pressure, and by means of a transformer, which was until recently the largest machine of its kind in existence, is reduced to 185 volts. This transformer has a maximum capacity of 830 kilowatts, or about 1,100 horse-power. Associated with it is a regulator, by which the current, as it comes from the transformer, can be varied and held at any voltage between 100 and 250.

About 4 per cent. of the current pass-

ing into the transformer is lost and appears as heat, and means must be provided to conduct this heat away and prevent undue rise of temperature in the transformer. Adjacent to the transformer and regulator are two oil tanks, one resting on the floor and the other directly above and about 8 feet from the floor. The second oil tank contains two coils of pipe, through which water continually flows. A small pump, run by an electric motor, keeps the oil circulating through the regulator, transformer and upper oil tank, the lower one serving as a reservoir for the excess of oil. The oil flowing through the electrical apparatus carries off the heat from it, and is in turn cooled by the water in the coils of pipe.

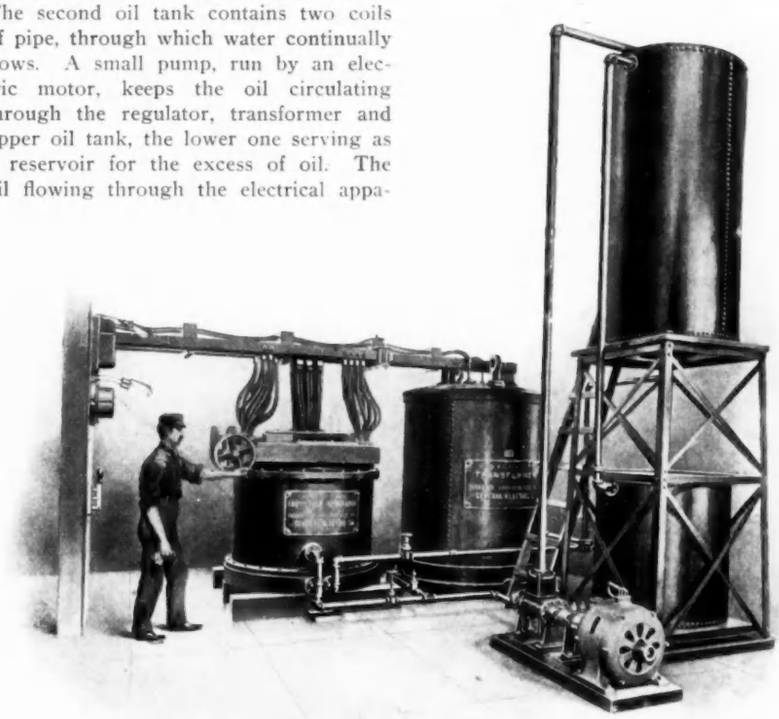

FIG. 3.—TRANSFORMER, REGULATOR AND TANKS FOR COOLING MEDIUM.

The current from the transformer and regulator is conveyed into the furnace room by two copper conductors having a sectional area of 8 square inches each. Heavy cables connected with the large main conductors are bolted to the plates of the furnace which is ready for the current. The circuit is completed in the transformer room by means of a water rheostat. This consists of a circular vessel made of iron, containing salt water, and a large iron plate which can be lowered into the solution. When the circuit is to be closed the iron plate is lowered into the water until it rests in the bottom of the vessel. Similarly, in breaking the current, the plate is lifted off the bottom of the vessel and out of the water. The object of this arrangement is to avoid the dangers which attend other methods of breaking circuits which convey such large currents.

The current is passed through a furnace for about twenty-four hours, after which it is allowed to cool for a few hours before the side walls are taken down and the furnace opened. First the unchanged mixture on top is raked off, then comes a crust of amorphous carborundum, which is cut through with steel bars and removed from the inner crust of amorphous carborundum. This is then removed with a spade, exposing the crystalline carborundum, which forms next the core, and of this there is about 4,000 pounds in a single charge.

Mr. Francis A. Fitzgerald, in an address delivered before the Franklin Institute last year, said:

A cross-section of a carborundum furnace presents an interesting and beautiful appearance. In the center is the core, which, on examination, is found to be very different in some of its physical characteristics from the coke of which it was originally composed. It no longer possesses a bright metallic appearance. Many of the kernels are quite soft, and can be squeezed between the fingers, leaving on them a mark like black lead. In fact, the high temperature to which the core has been raised has driven off all impurities from the coke, leaving nothing but pure carbon, either in the amorphous or graphitic form. From the core radiate beautifully colored carborundum crystals to a distance of 10 or 12 inches. A single furnace yields over 4,000 pounds of crystalline carborundum. Most of these crystals are not remarkable as regards their size, but in places where hollows have formed large hexagonal crystals are found, sometimes measuring ½ inch on a side. At the distance of 10 or 12 inches from the core the crystals suddenly cease, and instead we find a thin layer of a light-green color, which is the inner crust of amorphous carborundum. Beyond this is the outer crust of amorphous carborundum, and this also ends abruptly in unchanged mixture. Other curious substances are sometimes produced in the furnaces; for example, silica, which has the appearance of spun glass.

The crystalline carborundum taken from the furnace goes to the crusher seen in Fig. 4 and thence to wooden tanks, where it is treated for several days with dilute sulphuric acid, to remove all impurities. It is then washed, dried and graded from 15-minute powder to No. 8.

Carborundum is apparently infusible; for after a certain temperature has been reached decomposition commences, without fusion, and the crystals are broken up into carbon and silicon. It is quite insoluble in water or any acid. Its hardness lies somewhere between 9 and 10 degrees, probably very close to 10 degrees, which is the hardness of diamond. An attempt was made to obtain some idea of the relative hardness of diamond, corundum and carborundum by the following experiment:

A series of lines was scratched on a small plate of glass with each of the three materials and the scratches examined with a microscope. The appearance of the lines made by the diamond and the carborundum crystal was indistinguishable, but that made with the piece of corundum was quite different, being rough, and not presenting the clean-cut outlines of the other scratches. This seems to show that carborundum is much nearer diamond than corundum in hardness, although it is not as tough.

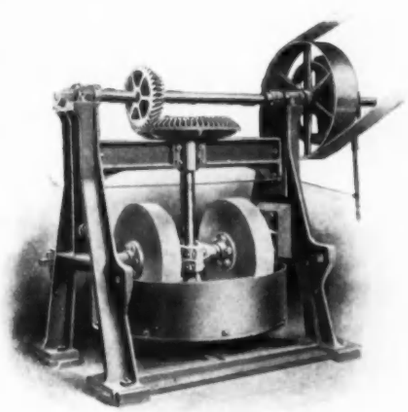

FIG. 4.—CRUSHER FOR CARBORUNDUM.

The specific gravity of carborundum is 3.23, which is less than that of emery, 1¼

pounds of the latter being equal in volume to 1 pound of the former.

Carborundum wheels are not molded of materials made semi-liquid by water and afterward dried, as is the case with emery wheels, but the material is only slightly moist. It is filled into a metallic mold and pressed, either by a hydraulic press or by an ordinary punch press, depending upon the size of the wheel, and is then at once ready for the kiln.

As to the service rendered by this new substance, watchmakers have found that it may be used in place of diamond dust—does the work practically just as well, and of course costs far less. It is extensively used in Aberdeen, Scotland, for polishing granite and far surpasses any other abrasive tried for that purpose. Rubbing blocks have enabled men to do in one hour as much work as had been done in a day with emery blocks. In grinding rolls and car wheels the endurance and efficiency of carborundum wheels have been found to be remarkable. Mr. Acheson's invention has, as will be seen, resulted not only in a new substance and a new industry, but seems destined to exert an important influence on many other industries as well, including that of the machine constructor.

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"The War—Why the Americans Will Win."

One of our Italian subscribers, Camillo Olivetti, sends us a copy of the Italian newspaper, "Avanti," dated May 27, in which we find an article under the above title ("La Guerra, Perchi gli Americani vinceranno"). We translate as follows:

"The first May number of the 'American Machinist' now reaches us. The 'American Machinist' is a good American journal, devoted to machinery, and is not a political publication. Nevertheless, this number is dedicated to the Spanish-American war, and certainly proves to be interesting, not only from a mechanical point of view, but even more so from a political one."

[Here follows a portion of an editorial article in the number mentioned, entitled "War and the Machinist."]

Then, continuing, the "Avanti" says:

"Here the journal ['American Machinist'] gives the description of the works accomplished by the war in the past month, and offers us a truly astonishing series of photographs of shops which, to within a few days, were engaged in the construction of machinery and now have completely changed their productions to cannon, armor plate, torpedoes, muskets, etc.

"What a lesson for the Latin races, so wanting in arms and poor in energy, this young State affords us, which, with portentous adaptability, in a few weeks puts itself in condition to wage a war of defense or of offense, before which might recoil not only exhausted nations like Spain, but nations also that pass for the more powerful!

"The United States is strong because fundamental liberties there have never been trodden under foot; because the energies of the nation have not been scattered for years in exhausting armaments, and because such energies were employed instead in industry and commerce and in elevating the condition of the masses.

"And now this system, which is really liberal, which has rendered the nation so prosperous in time of peace, makes it powerful in time of war; because it is true that out of a good citizen, whose material wants are well supplied and who is of a certain moral understanding, a valuable defender of the fatherland, when necessary, may be made; so out of a good machine shop, in case of need, an excellent arsenal may be made.

"The United States, though temporarily beaten in some encounter, will win in the long run in the war with Spain, not because more numerous, but solely because a continuous system of true political liberty has made possible the productive development of those energies which alone can make a nation truly strong."

[It may be noticed that our Italian friend wobbles just a little occasionally in the above, but in the main is undoubtedly right. Fundamental liberties have been trampled upon here, notably by the long maintenance of human slavery, and there are problems yet to be solved by us before it can be truly said that no natural right is trampled upon in America. Not so many fundamental liberties are trampled upon here as in Italy and Spain, and to that extent we are better off, for, other things equal, nations become great and powerful in proportion as their citizens are allowed the greatest possible liberty of action consistent with the equal rights of all.—ED.]

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A Steady-Pin Lathe.

BY A. H. CLEAVES.

The special tool illustrated in this article has been of extensive service in years past, and were I acquainted with the designer I should be glad to mention his name.

In Fig. 1 *i* and *j* are the balance bridge and barrel bridge, respectively, of a watch; and the six steady pins, whose positions are shown by the dotted circles, are the pieces which this machine was especially intended to make. Its general utility, however, for similar work will appear later on. The holes for these pins are drilled in the bridges and tapped, being blind holes, *i. e.*, not coming clear through. Their corresponding holes in the plate are drilled or punched. The steady pins are threaded in the lathe, then nicked and run into the tapped holes in the bridges, being twisted off by the revolution of the lathe.

In the eleven figures furnished the numerous details illustrate long tried mechanical movements that can be relied on for their respective functions in any place. The base *A* is conected with the body *B* by a shoulder bolt, the lower part of which is threaded for bolting to the bench.

The attachment *C*, at the left, is a frame for carrying the chuck-opening lever *D*. This has a knob at the end, and a downward pressure on this brings the fork of *D* (seen in end view at Fig. 2) against the drawing-in spindle *I*, and opens the wire chuck *H* while the lathe is running. The wire feeds through the chuck to the stop pin or screw *e*, shown in the swinging tailstock *F*.

For guiding the wire and feeding it a tube *Z*, carried in two or more standards *W*, and furnished with a gravity device, is used. The tube *Z* is soldered to the tops of the openings in the standards (see Fig. 8) and is sawed open along the bottom. A rod, carried by a metal slip, *X*, running in the groove in *Z* carries the material or wire along through the chuck *H*. This push rod with *X* has a cupped end for the wire and a cord or chain attached to *X* and running over the pulley *Y* (Figs. 8 and 10), as shown by the dotted line and arrow, has a weight on the end for carrying the wire. The standards *W* are fastened to a wooden base in this case to bring them high enough or opposite the lathe spindle.

The stiff spring *M*, between the shoulder on the end of the drawing-in spindle *I* and the lock nut *L* on the lathe spindle, keep the chuck *H* closed on the wire, except when pressed open by *D*. The parts *M*, *L*, *K*, *I*, *J* and *H* all revolve together; and instead of the set screw in *L* it is customary now to saw through the nut and pinch it together for locking. The adjustable bearing *K*, sliding upon the spindle *J*, has a screw with point entering slot in *J*, which prevents *K* from turning and loosening the nut *L*. The bearings *N* are pressed into *B*, after being hardened and ground.

In fitting the hardened spindle *J* and sleeve *K* to the bearings it is customary to grind the parts until they pinch a piece of tissue paper on the short angle when put together; then they are run together and the bright parts stoned off until a fit is made. A piece of square washita stone held in the hand is used while the work runs; that is, the spindle *J* and *K*.

O O are brass dust guards. Casting *B* is chambered for oil wells around the bearings. *E* is a stationary spindle, carrying cutting-off tool frame *G*'s tailstock *F* and accessories. The spring box and stop piece *S* is fast on *E*. The arms of same (see Fig. 4), with adjusting screws,

regulate the position of threading-die spindle *R* and stop screw *e*. When at normal position the screw die stands opposite the work; the length of the latter being determined by the collar *U* with pin, passing off the guide bar when enough threads are cut. Reversing the lathe runs the die off. *G* swivels on *E*, being thrown back with coil spring, one end in *G* and one in *B*. A wire attached to lower end of *G*, connected with a treadle, throws cutting-off tool *a* in. Stop screw *d* against pin *h* fixes the depth of cut for *a*. Tool holder *v* for *a* swivels at *f*, and is adjusted for hight with screw *c* against pin *g*, moving in opening *g*. (See Figs 5 and 6.) The spindle *R* is ground and hardened, and has soft steel plug in the end for taper boring to carry screw die. The latter is made on a steel plug, having a tapering end, where die comes and ring for closing the split end together. One bearing *T* is fixed, the other is adjusted and locked with two screws. End of *I* and points of *D* at the fork are tempered.

Chicago, Ill.

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Sampling and Testing Lubricating Oils and Fats in the Workshop.*

The analysis of oils, fats and greases is a branch of analytical chemistry which can be successfully undertaken only by an expert analyst who has made such materials his special study. But for ordinary purposes there are some ready yet accurate means of ascertaining whether a lubricant oil or fat is pure or not, and, if not, what is the nature of the adulterating body. Such methods can be easily practiced by the skilled operators in the workshop by paying careful attention to the following instructions, being very accurate in all measurements, and faithfully following the modus operandi in the order given. By doing this many foremen can successfully undertake to determine the purity or otherwise of the lubricants used, and thus not only save the firm's money for analysis, but also avoid the delay incidental to submitting samples to chemists.

There are more than half a dozen methods of testing oils and fats. Those, however, which are available for our purpose are the following: Ascertaining the specific gravity; action of alkalies in oils and fats; action of sulphuric acid on oils, etc.; testing for presence of free acid; testing viscosity; testing rate of evaporation. The above tests are taken in the order named.

Method of ascertaining the specific gravity of oils.—As oils are lighter than water there is only need to describe one method

* Reprinted from "The Engineer," London. Slightly condensed.

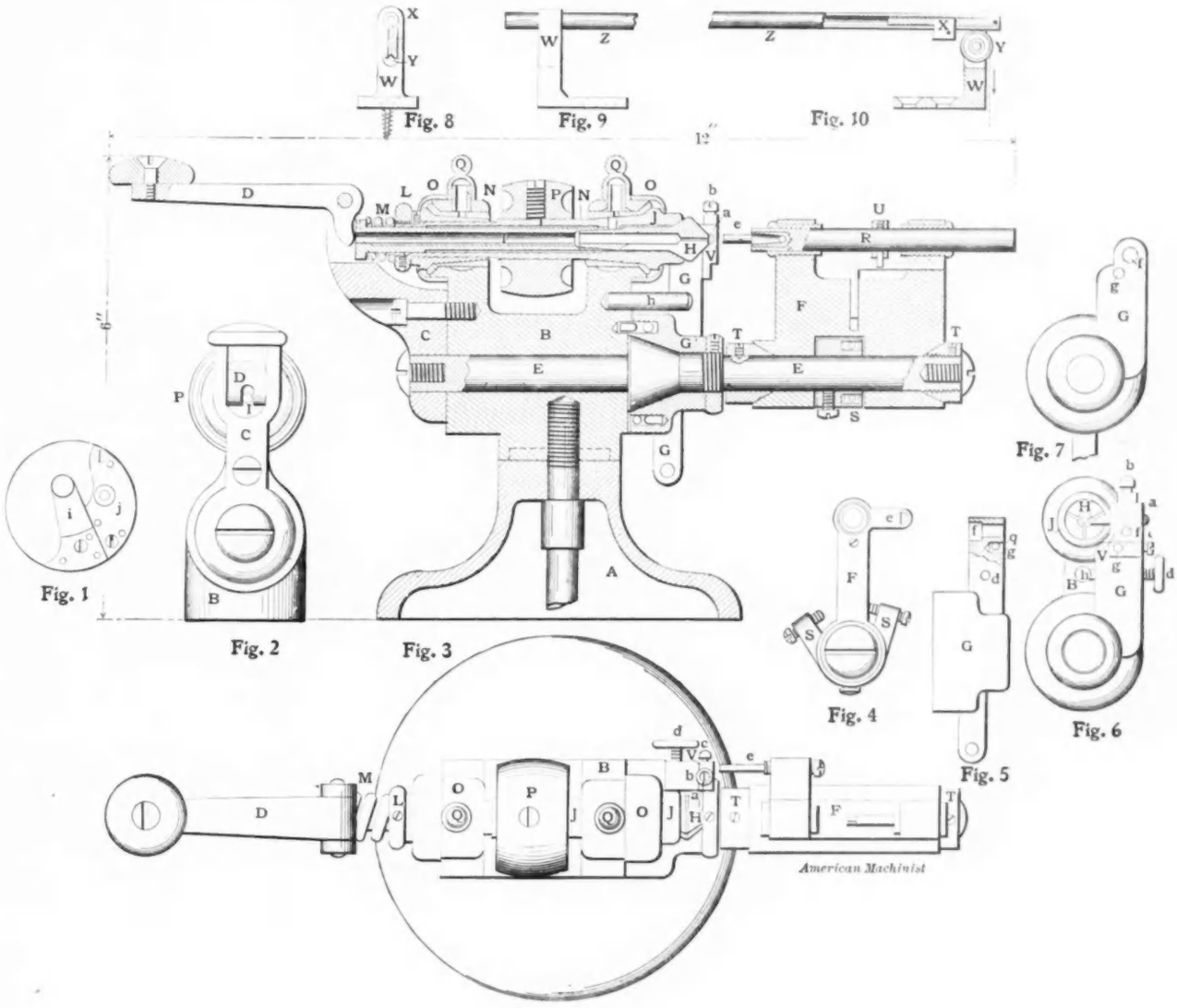

Fig. 11

A WATCH FACTORY STEADY-PIN LATHE.

of ascertaining the specific gravity. The principle on which the specific gravity of a fluid lighter than water is ascertained is to make a direct comparison between the weights of equal bulks of the two fluids—water and the oil to be tested. For this purpose a bottle or flask of a special make—called a "specific gravity" or "weighing" bottle—is used. This bottle is constructed so as to hold a definite quantity of water at the normal temperatures, viz., 60° Fahr., 15° Cent. The fluid contents of the bottle is usually 100, 500 or 1,000 grains of pure water at that temperature—water, it should be remembered, varies in weight according to its temperature, an increase of temperature rendering it specifically lighter and a decrease specifically heavier than when weighed at the above normal temperatures.

The specific gravity bottle has a closely fitting glass stopper through which a capillary tube is made, the object of which is to permit the escape of superfluous fluid. On the side of the bottle there is scratched a mark which indicates where the given quantity of water the bottle contains reaches when weighed at the normal temperature. This bottle is filled with the specific quantity of water it is constructed to hold and the stopper inserted and pushed down until the lower end of the stopper is coincident with the mark in the neck; the bottle is then wiped and weighed. Suppose the bottle weighs 120 grains, which, we will say, holds 100 grains when empty and dry, when filled with pure water at the normal temperature, the bottle and its contents will weigh 220 grains. If now the bottle is filled with oil instead of with water then the weight of bottle and oil will at once indicate the relative weight of oil and water, *i. e.*, the specific gravity of the oil. Thus, suppose the bottle and its contents—of oil—weigh 213 grains, then by subtracting the weigh of the bottle—120 grains—we shall find the weight of the oil which is equal in bulk to the water which the bottle is constructed to hold, *e. g.*, (*a*) weight of dry empty bottle, 120 grains; weight of bottle full of water at standard temperature, 220 grains; then 220 — 120 = 100, weight of water; (*b*) weight of dry empty bottle, 120 grains; weight of bottle full of oil, 213 grains; then 213 — 120 = 93 grains, weight of oil. The specific gravity of the oil is 93-100, or 0.93. By using a bottle constructed to hold 1,000 grains of water then the specific gravity can be carried to three places of decimals: Weight of bottle full of water at standard temperature, 1,120 grains; weight of bottle when dry and empty, 120 grains; weight of water, 1,000 grains. Weight of bottle full of oil, 1,052 grains; weight of bottle dry and empty, 120 grains; weight of oil, 932. In other words, a volume of water weighing 1,000 grains can be occupied by a volume of oil which weighs only 932 grains; therefore, although the two fluids are equal in bulk, the weights are different, viz.,

$$\frac{\text{oil}}{\text{water}}\ \frac{932}{1000} = 0.932 = \text{sp. gr. of the oil.}$$

Now, the specific gravity of any two different oils, if pure, is never identical. If the specific gravity of an oil, say, linseed, the specific gravity of which, when pure, is .932, is less than .932 (say, for example, .920), then we know that it is not linseed oil pure and simple, but a mixture, one of the components of the mixture being yet lighter than linseed. As the range of specific gravity of oils varies so slightly, it is very important to be accurate in ascertaining the exact specific gravity, and to insure accuracy it is best to operate on fairly large quantities of the oil—say, 1,000 grains at least. As the specific gravity bottle is graduated to hold a definite quantity of water, it is not necessary to fill it with water, and weigh some, before testing the specific gravity of oils. All that is necessary is to weigh the dry bottle, then fill with oil up to the mark on the neck of the bottle. Insert the stopper, allow any surplus oil to flow out through the orifice in the stopper, being careful to put the stopper down to the mark completely; then wipe dry, and afterward weigh the contents in the manner given above, when the specific gravity of the oil is at once obtained. After use, empty the bottle of the oil and perfectly clean it, using first a strong solution of caustic soda or potash, or else carbonate of soda and lime and a little water; but for oil which does not readily saponify with these alkalies use either strong liquid ammonia or else ether or alcohol, rinse thoroughly, and afterward rinse in a little ether and dry. As the ether evaporates it will carry away all traces of moisture, then insert the stopper in the bottle and place it in its tin case to keep it dry, to prevent it imbibing moisture, the presence of which in its interior would materially affect the results obtained by weighing oil in it. If any oil be allowed to dry in the interior of the bottle it will be doubly hard to remove; a little essential oil of lavender is a remedy for softening hard, dry oils preliminary to removing them by the above means.

Besides the above, there is another method of readily ascertaining the specific gravity of oil, which consists in the use of a hydrometer. The common form of this instrument—termed an oleometer—is seldom accurate. The instrument consists of a glass tube hermetically sealed. Inside is a paper scale graduated into divisions which represent so many degrees specific gravity. At the lower end of the tube is a bulb filled with mercury, or small shot, so as to cause the instrument to sink into the oil and steady it to keep it upright. This instrument is used by filling a tall glass jar with the oil to be tested and then immersing the hydrometer in the fluid, the specific gravity of which is indicated by the degree to which the instrument sinks, as shown by the paper scale inclosed; thus, the denser the fluid the less will the instrument sink. More than one instrument is used for the whole range of oils and fats, because the scale of each is divided into only a small number of degrees. An instrument with a scale of 0.730 to 0.860 is needeed for the lighter oils—naphtha and burning oils—and one with a scale from 0.860 to 1000 for the various grades of lubricating oils.

It should be mentioned that the temperature of the oil should always be taken at the time of testing its specific gravity, and it should be brought to the uniform standard temperature—60° Fahr.—by warming it or cooling it, as the case may be, because the specific gravity of oils varies according to the temperature. To accomplish this, after filling the specific gravity bottle, and before putting in the stopper, stand the bottle in a vessel of water, the temperature of which is 60° Fahr. When the oil has acquired a similar temperature, take out the bottle, wipe off all moisture, insert the stopper to the mark in the neck, wipe away any superfluous oil that overflows, and then proceed to weigh as already described.

It should be borne in mind that the specific gravity of an oil does not determine its absolute purity. Other tests have to be made to determine that. Thus, for example, suppose a fraudulent oil refiner were to sell an inferior lubricating oil as one of a superior class; his first object would be to blend the components so as to render the compound of exactly the same specific gravity as the genuine superior oil. Consequently, if the operator were to rest satisfied, when he found the specific gravity was right, that his tested sample was the genuine oil, he would be committing a grave error; therefore the specific gravity test is only useful in telling in a quick way when an oil is pure. This may seem paradoxical, but it is explained when we say that the production of an exact specific gravity of oils by the immixture of several components is so difficult that perhaps nine out of ten components fail to indicate the exact specific gravity aimed at. Consequently, if the operator found a material difference of, say, .005 to .01, he would at once know that that oil was not the genuine one it was represented to be. For example, the specific gravity of linseed oil at the standard temperature is 0.932; but suppose the operator found on testing a sample that the specific gravity of the sample showed 0.925 or 0.937, he would at once correctly surmise that the oil under examination was not pure linseed. To determine what such sample was really composed of would require other and more elaborate tests than finding its specific gravity.

The specific gravity of solid fats, such

as palm oil, cocoanut oil, butter, etc., is not so easily ascertained as that of fluid oils. One of the simplest methods is to take a wide test tube that can be tightly covered with a cover, such as a boxwood cork stopper. First weigh the tube and its stopper while perfectly clean and dry, then fill it with water, wipe off all moisture from the outside and weigh it again, then empty it of water and perfectly dry it, and having melted at a low temperature some of the solid fat to be tested, fill the tube with that, and allow it to cool down, and again weigh the tube with the solid fat in it. The specific gravity of the solid fat is then easily ascertained by the calculations already referred to. Thus subtract the weight of the tube and cork from the weight of the tube, cork and water; also subtract the weight of tube and cork from weight of tube, cork and fat, and then divide the weight of the fat by the weight of the water, when the specific gravity is at once obtained, *e. g.*: Suppose the weight of the tube, cork and water be 250 grains; weight of tube and cork be 50 grains; ∴ weight of water equal 200 grains. Weight of tube, cork and fat, 245 grains; weight of tube and cork, 50 grains; weight of fat, 195 grains.

Therefore sp. gr. $\frac{195}{220} = .97\frac{1}{2} = 0.975$.

The following specific gravities are those of the oils most commonly used in making lubricating compounds, the specific gravity, as given below, being taken to be when the oil is at the standard temperature, viz., 60° Fahr.:

0.875 mineral oil.	0.919 almond oil.
0.883 sperm oil.	0.923 cotton seed oil.
0.903-7 mineral oil.	0.923 sesame oil.
0.912 lard oil.	0.925 whale oil.
0.912 tallow oil.	0.925 cocoa nut oil.
0.914 rape oil.	0.925 mineral oil
0.914 neatsfoot oil.	0.932 linseed oil.
0.915 olive oil.	0.940 palm oil.
0.920 arachis (ground or earth nut) oil.	0.940 tallow.
	0.964 castor oil.

(To be continued.)

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The Mundo Ellipsograph.

BY MORRIS FULTON.

Recent articles in the columns of the "American Machinist" have had to do with the production and use of irregular, or, rather, unusual and non-circular, shapes in machine shop work, and especially the ellipse and figures approximately elliptical. I suppose there can be little doubt that elliptical shapes would be adopted more frequently in machine construction if they could be produced with the same facility and as cheaply as circular work. In the fastening of wheels on shafts securely, and in the location of cams and levers in immovable positions, the ellipse might become an important element if its use did not involve considerable trouble and unusual operations and appliances to produce.

I have nothing to say here about the practical lathe arrangements by which elliptical shapes may be accomplished, because the deterring factor as to the more common use of the ellipse is really in the drafting-room. Draftsmen do not like to use the ellipse in common everyday work, because it is a bother and involves unusual instruments and operations to draw it. The ellipse is so out of their common practice that it is also out of their thoughts. Draftsmen and designers do not habitually think ellipses as they do circles, and it can scarcely be said that the ellipse has a fair and equal chance with the circle for selection upon its merits in any given case. Every draftsman, of course, knows well enough how to construct an ellipse, and various instruments are available for the purpose, but still the ellipse and the draftsman do not become intimate friends. The trouble about the elliptical part of it also contributes largely to discourage the use of isometric and other styles of projection, which otherwise might be serviceable in delineation.

In this connection I take pleasure in bringing forward a sketch and brief description of the ellipsograph that we made at the Mundo Iron Works, and which became a favorite with the draftsmen there. The convenience of it was in its use for small ellipses, and of these it drew a great many. It was practically almost as easily operated as a pair of compasses. It was accepted at first probably as a neat and perhaps a somewhat ingenious plaything, and the boys amused themselves in drawing various pretty symmetrical designs with it, but its facility soon secured its employment for important and valuable work. It would draw, from any given point as a center, either a dot, a circle of any diameter, a straight line in the direction of either axis, or an ellipse of any size or ratio of axes up to its limit of 4x6 inches. Any complete and perfect ellipsograph should of course be able to do the same, but it is not frequently done. We never got any satisfactory pen to work with it, and that was the only unsatisfied want that developed in connection with its use.

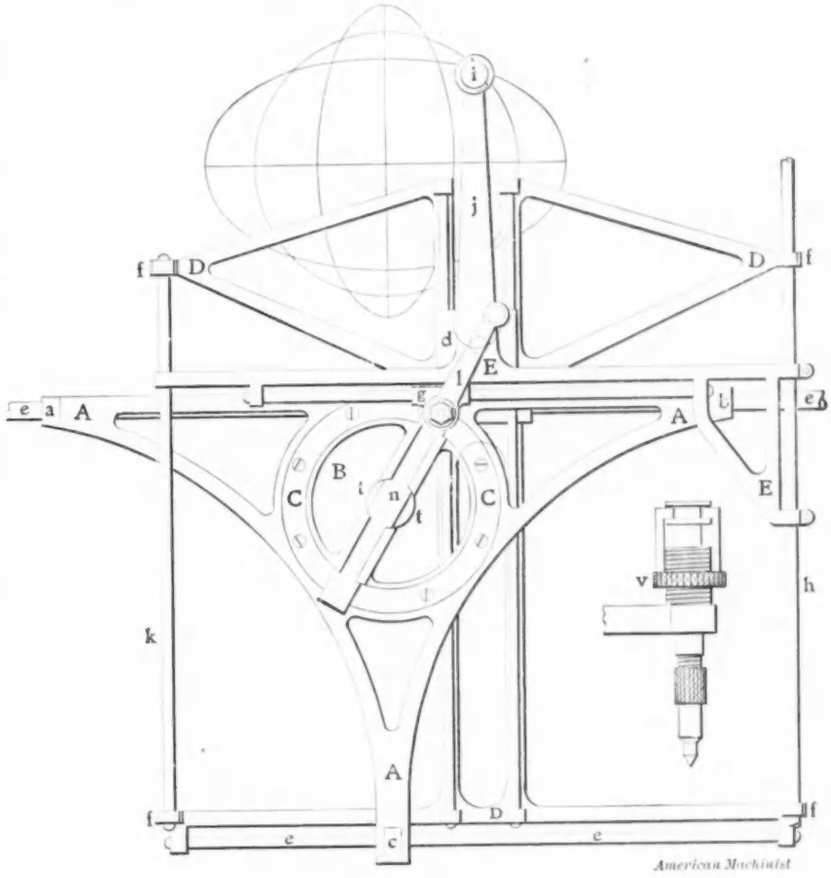

Fig. 1

THE MUNDO ELLIPSOGRAPH.

Fig. 1 is a plan of the instrument as in use on a drawing board, and Figs. 2 and 3 show one or two essential details, and between them a clear understanding of the instrument may be obtained. The main frame *A* has three feet, *a b c*, which rest upon the board and support the entire apparatus. This frame is flat on top and also under, except for an increase of depth on the under side around the large central circle. The crank carrier *B* is a

circular ring with a cross bar which revolves freely in the frame. It is supported by and turns on the shoulder *i*, there being two different diameters to the hole in the frame, and is held down by the thin circular ring *C*, which is sunk into the frame so that it is flush with the top, and is held in place by the eight little countersunk screws as shown. This revolving crank carrier has two parallel raceways, one on top and the other under, in each of which is a sliding flat bar with a vertically projecting crank pin, the pin *o* of the under bar *m* projecting downward and the pin *p* of the upper bar *n* projecting upward, this upper pin *p* having secured upon its upper end a crank arm *l* parallel to the bar and extending out far enough for turning the crank carrier *B* when the bar is drawn in and the pin *p* is brought to the center of the instrument. This crank is used for describing the ellipse by turning the crank carrier

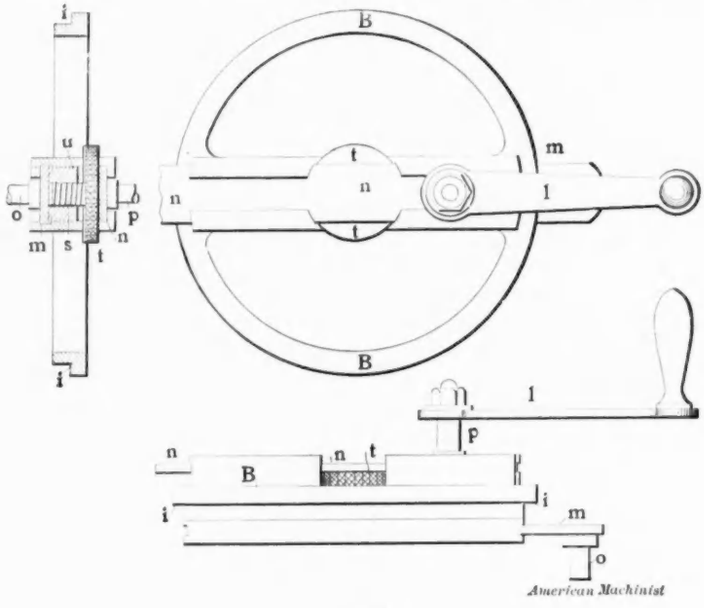

Fig. 2
CRANK CLAMPING DEVICE OF MUNDO ELLIPSOGRAPH.

B and giving motion to the several parts. The sliding crank bars are adjustable endwise to give the required throw to the cranks according to the dimensions of the ellipse to be described. They slide freely in and out until secured by the clamping device. This consists of the screw *s*, which is left handed, with the flat knurled head *t*, and the square vertically sliding nut *u*. The head of the screw sets in a counterbore in the upper side of the crank carrier *B*, projecting at the sides so that it can be turned by the thumb and finger, while the nut slides in a square hole below it. Both the screw and nut are between the bars *m* and *n*, and turning the screw in the direction which sends the nut down and the screw up binds both bars *m* and *n*. The head of the screw has a slight central projection on top for contact with the bar *n* without causing too much friction. The left-handed thread gives a right handed movement for the head of the screw when clamping.

A rather careful scrutiny of Fig. 1 may be necessary to understand the position and arrangement of the sliding frames, although simple enough when understood. It will be well to note how the parts lap over and cover each other, so that it may be clearly understood which are above and which below.

The cranks and carrier being in place in the frame, the pin of the lower crank fits in the sliding block *d* in the lower sliding frame *D*. The revolution of the crank causes a lateral movement of the frame *D* corresponding to the throw to which the crank may be adjusted. This lateral movement of the sliding frame *D* corresponds usually with the larger axis of the ellipse, as the lower crank is capable of the longest throw. Within its capacity, however, the instrument may of course be set and used parallel to either axis. The rods *e e* are the slides which carry the lower sliding frame *D*, both being fastened in it and moving with it. The four uprights *f* on the sliding frame *D* serve as guides for the sliding rods of the upper sliding frame *E*. The right hand rod *h* is fastened in the frame *E* and slides with it, but the left-hand rod *k* is fastened at the ends in the uprights of the lower frame, and the left-hand end of *E* has a hole fitting the rod, and that end of *E* slides upon the rod. While the lower frame *D* moves laterally, as shown in the drawing, the upper frame moves at right angles to it, and is operated by the pin *p* of the upper crank bar working in the sliding block *g*. This upper sliding frame has the forward projecting arm *j* which carries the pencil for describing the ellipse. The pencil, which is the ordinary round lead, held in the familiar clamping device, is raised and lowered by the knurled nut *v* with the two uprights and the inwardly projecting fingers, as shown in Fig. 3. If the nut is run all the way up the pencil carrier and pencil may be lifted right out for the adjustment or sharpening of the lead, or for any other purpose. The point of the lead should be central in the holder, and it could not be otherwise except by unskillful sharpening.

Both of the crank arms have little stop pins which bring the crank pins to the center of the crank carrier *B* when the arms are thrust in, and if clamped in that position and the crank carrier is revolved, the pencil will have no motion, or, as we may say, it will describe a dot. With the pencil in this central position the location of the instrument for describing an ellipse in a certain position and of given dimensions is a simple matter. The two axes of the ellipse are drawn and the dimensions of the ellipse laid off upon them, or upon one arm of each. The two front feet *a b* of the instrument are placed against the blade of a T square, if the axis of the ellipse is normal to the board, or a line may be drawn parallel to one of the axes of the ellipse and at a distance of 2½ inches from it, and the front of the feet *a b* placed to coincide with this line, the point of the pencil being at the same time placed at the intersection of the axes of the ellipse. The crank carrier is then turned to bring the crank bars *m* and *n* parallel with the front of the instrument, which makes them also parallel with the long axis of the ellipse. The crank binder screw is then slackened and the lower slide *D* is moved sidewise until the pencil point is brought to the indicated dimension, the crank bar *m* of course also sliding out at the same time. This gives the right throw to one crank, and it is then clamped and the crank carrier is then turned 90 degrees or brought parallel with the other axis. The crank binder is slackened again, and the pencil is brought out to the required dimension upon this axis by the movement of the upper sliding frame *E* and the upper crank bar *n*, and when the cranks are clamped again the instrument is ready to describe the ellipse, which is done by lowering the pencil as much as may be necessary and then turning the crank around the circle. In adjusting the throw of the cranks, when the crank is parallel with either slide, the adjustment of the crank for the other slide is not impaired, although it is at the time unclamped. Fig. 1 is one-half size, and Figs. 2 and 3 are full size. The drawings are not perfectly correct working drawings, but show all the essential details, and a bright man in a tool room or elsewhere should have no

difficulty in making the instrument. The frames were bronze castings and the rods were "Crescent" drill rods. The pencil holder also was made of steel, but brass would probably have been better.

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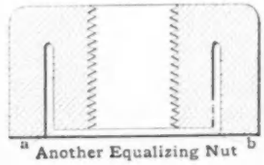
Letters from Practical Men.

Tension on Bolts and Nuts—Incorrect Reducing Gear.

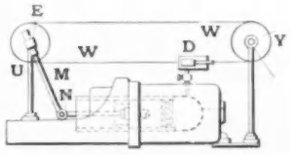
Editor American Machinist:

I should judge that the various suggestions recently illustrated in the "American Machinist" with the object of equalizing the tensions on nuts and bolts would be regarded by the average practical man as an over-refinement of machine construction. However, the fact that such a high class concern as Sulzer Brothers have considered it policy to make so drastic an alteration in the form of their nuts would seem to show that there is some justification for the departure from usual practice, at least under the particular circumstances mentioned by Mr. Miller. The subsequent modifications proposed by Professor Sweet and Tecumseh Swift, while carrying the suggestion to its logical conclusion, necessitate more or less complicated constructions which I am much afraid would not be tolerated in most cases. If, however, the ordinary nut could be easily modified in such a manner as would approximate to the conditions laid down, there would seem to be a greater chance of the principle being applied in practice, and it appears to me that such a result could be arrived at by cutting a circular recess in the nut, as shown in Fig. 1. The surface *a b* would be cut back slightly so as to insure bearing on the outer part only of the face of the nut in the manner indicated. We should then have a compromise between the Sulzer and Tecumseh Swift's Fig. 4, page 426, issue of June 9. Of course the recess would be made as narrow as practically possible, with a view to prevent the nut being weakened more than is absolutely necessary. But if the latter is still an objectionable feature, it would be an easy matter to increase the outer dimensions of these special nuts so that they would fit a wrench a size larger than the standard.



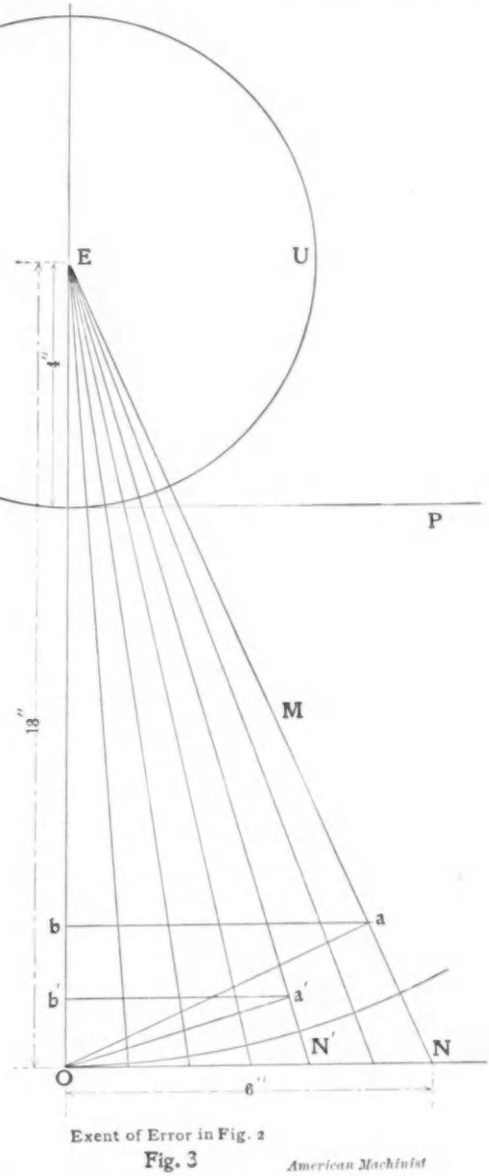
Another Equalizing Nut

Fig. 1



A Defective Indicator Reducing Gear

Fig. 2



Exent of Error in Fig. 2

Fig. 3 *American Machinist*

AN EQUALIZING NUT. DEFECTIVE INDICATOR GEAR.

Notwithstanding all that has been said and written with reference to incorrect reducing gear for indicators, a great carelessness is still being evidenced in this connection. One of the most serious of recent instances is to be found in the indicating arrangements adopted in some elaborate tests of a gas engine, a report of which has recently been presented to the Institution of Mechanical Engineers in London. I have often remarked in these columns that the greatest refinements in one direction are often found in company with the most egregious errors in another. The present case is no exception, for, while it was considered necessary to use a sheet of smoked mica on which to trace the diagram in order, as it was stated, to, "reduce the pencil friction to a minimum," the reducing motion was such that the card would be about ¼ inch shorter than a correct gear would give, while the movement of the card near the end of the stroke would be about 17 per cent. too slow. Under any circumstances this would be a serious error, but it is particularly so in the case of power measurements from a gas engine diagram, where so much depends upon a correct motion being given to the card at the explosion end of the stroke. The arrangement which is shown in Fig. 2 (taken from my recently published work on the indicator*) will be seen to consist of a pendulum rod *M* sliding telescopically in a sleeve *E*, the center of which coincides with the center of the grooved pulley *U*. The lower end of *M* is pin-jointed at *N* to a bar fixed in and virtually forming a part of the engine piston. Another pulley *Y* of the same diameter as *U* is carried by a standard shown, and over these two pulleys a wire *W* is stretched, this being fastened to *U* and also attached to the slide *D* of the Wayne indicator employed. The diameter of *U* is 8 inches, the stroke of the engine 12 inches, and the distance from the center of *E* to the horizontal path of *N* is 13 inches.

Referring to Fig. 3, where the positions of *N* for successive inches of the half stroke are shown, it will be seen that at the end of the stroke the tangent

[* The Indicator Handbook. New York: D. Van Nostrand Company.—Ed.]

of the angle between the rod M and the vertical $O\ E$ is

$$\frac{ON}{OE} = \frac{6}{13} = .4615$$

The angle $O\ E\ N$ is therefore 24° 46′, or more conveniently 24.77°. The circumference of the pulley U is 25.132 inches, so that the movement given to the point P in the wire, while N moves from O to N, is

$$\frac{24.77}{360} \times 25.132 = 1.723 \text{ inches.}$$

With a correct gear the movement given to P would be

$$\frac{4}{13} \times 6 = 1.846 \text{ inches,}$$

so that the deficiency in the half stroke is .123 inch, or approximately ⅛ inch, as stated.

The investigation of the velocity relation of N and P at any point in the movement calls for the use of the differential calculus. It will, however, be sufficient for my purpose to state that it can be shown that the motion of N is to the motion of P as $1:\cos^2 \alpha$. α being the angle as $O\ E\ N$. (For proof of this statement see Thurston's "Engine and Boiler Trials," page 178.)

The cosine of 24° 46′ is .908, and squaring this gives .8244 as the motion near the end of the stroke, so that the movement of the cord P is $100 - 82.44 = 17.56$ per cent. too slow. A simple graphic construction shows the amount of this error very clearly at any point. Draw from O a line $O\ a$ at right angles to $E\ N$, and from a draw $a\ b$ parallel to $O\ N$. Then the motion of N is to the motion of P as $E\ O$ is to $E\ b$. Similarly when the piston occupies the position corresponding to N′, the velocity ratio of

$$\frac{P}{N} = \frac{E\ b^1}{E\ O}$$

M. E.

Manchester, England.

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Index Ring for Turrets.

Editor American Machinist:

Some years ago, when I was employed as tool maker in a large establishment, I had the pleasure of an opportunity for studying into the turret lathe mechanism of the Pratt & Whitney screw machine as then made. We were building a part of such a machine, which was required to be of a size not built by the Pratt & Whitney Company, and in making the drawings for our own machine we naturally tried to study into the why and wherefore of each feature.

Nothing about the machines interested me more than the index ring and locking bolt by which the turret was held in position during a cut. It seemed to me to be in some respects a stroke of genius, and I am reminded of it by seeing in your issue of July 14 engravings and description of a turret mechanism, by which it seemed evident that one man at least had utterly failed to understand the object of what I considered one of the most beautiful features of the mechanism. This feature will be understood from an inspection of Fig. 1, in which *a* is the hardened steel index ring and *b* is the locking bolt, which is square in section. Now, it will be noticed that one side of this locking bolt is a continuous straight line and that it lies in a line radiating from the center of the turret, the bevel necessary to enable the bolt to bring the turret into proper position being all on one side of this locking bolt. At first glance it seemed curious that the bolt should be made in this way, but upon further examination it was seen that there is good reason for this.

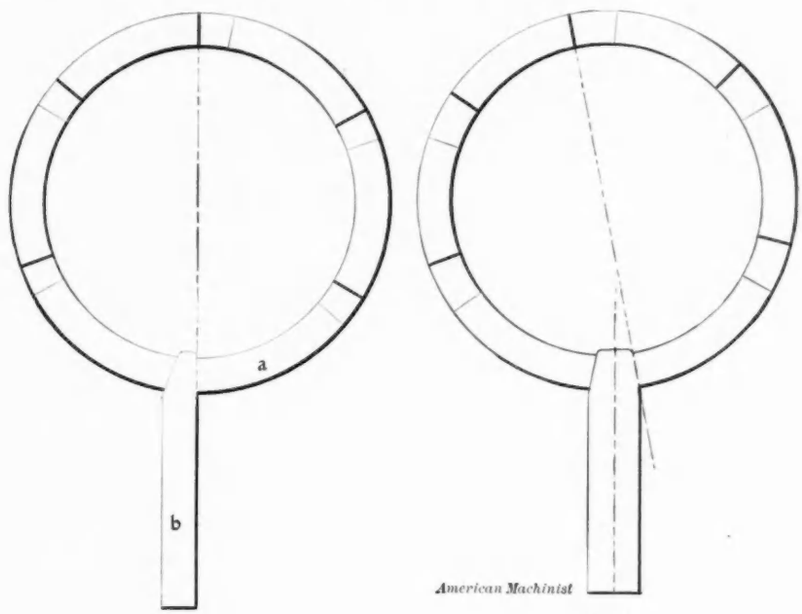

Fig. 1 Fig. 2

INDEXING ARRANGEMENT FOR TURRETS.

We all know that in cutting these index notches through the ring it is necessary to take at least two cuts, because the sides of the notches are not parallel to each other, so that we must first go around the ring to cut the radial sides of each notch, then set the index head off the center and go around again to cut the bevel side of each notch. By making one side radial, placing the bevel all on the other side and then making one side of the locking bolt straight, this bolt when forced into position by the spring provided for that purpose will naturally first contact with the bevel side and will by its further advance bring the radial side of the notch into contact with the bolt, and as soon as this contact has been established there will be no further movement of the bolt and consequently the wear on the radial side is reduced to practically nothing. Then, too, if in cutting the ring one notch happens to be made somewhat larger than another, or if, in other words, the radial sides of these notches are indexed correctly, but the other sides are not indexed correctly, the turret will still be indexed properly, because it will always be the radial side of the notch which will control the position of the turret, the spring-impelled bolt simply advancing farther in a large notch than in a small one, but without moving the turret, because the movement of the bolt is in line with its straight side, and such further movement of the bolt as is necessary to fill the notch can take place without moving the turret upon its axis.

This is especially convenient when repairs are to be made, and it is necessary at such a time only to true by grinding or otherwise the radial side of the notches and to see that they are correct; the other side of each notch may be simply smoothed up to fit the bolt and no attention need be paid to accuracy of that side, or to uniformity of the size of the notches.

Reference to Fig. 2 shows how neatly the designer in question avoided the advantages of this arrangement. He also made one side of each notch radial evidently because he found that "they were made so," but in arranging his locking bolt he has distributed the bevel on each side of it equally, which, of course, makes it necessary that the center line of each notch should be exactly accurate, that is to say, that each side of each notch must be exact, and upon a little reflection it is plain that notwithstanding one side of these notches is radial, all the advantages resulting from such radial arrangement are completely and effectively

avoided. There is no object whatever in making one side of the notch radial unless one side of the locking bolt is straight and lies in that radial line, as shown in Fig. 1.

If I knew the name of the genius who conceived this idea and caused it to be embodied in the P. & W. machines I should like to give him the credit for it. He deserves much credit in my opinion.

S. T. FREELAND.

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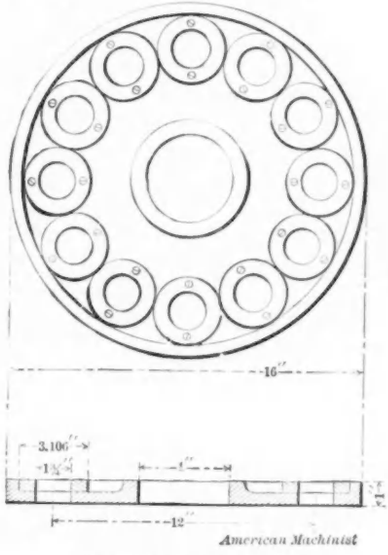
An Original Index Plate.

Editor American Machinist:

As the subject of original indexing seems to be of interest at this time, a description of an indexing jig may not be out of place.

Having a job requiring twelve holes equally spaced and in a 12 inch diameter circle, and no dividing head accessible that was accurate enough for the purpose, we succeeded by using the following plan, which may be in some parts considered as similar to Mr. Thorne's described in your issue of June 9.

As our jig was to be used on several pieces of different sizes and shapes, and requiring holes of various sizes, we used



AN ORIGINAL INDEX.

bushings in the rings to guide the several tools.

The rings, made substantially as Mr. Thorne described, were ⅝ inch thick by 3.106 inches diameter and with 1¾ inch closely reamed hole, and were held in place by two countersunk head screws. They were mounted on a plate 16 inches diameter, having a 4 inch central hole, and flanges carried around both hole and edge 41-64 inch high. This plate was turned and so fitted as to just admit the rings within the outer flange, and they would not fall out even when the plate was turned over and laid down with some force before they were fastened. The holes in the rings were continued through the plate and slightly enlarged by counterboring to avoid any bearing except in the rings. The jig was used with centering guide rings and plugs and clamped to the work.

The required diameter of the rings to bring their centers at 6 inches radius and 12 in a complete circle is obtained as follows: The 360° of a complete circle are divided by 12, the required spacing, giving 30° of arc contained between adjacent holes. Now, to find the chord of the arc of 30° at 6 inches radius, which is the same as the required diameter of our rings, we use a principle of trigonometry, which is that the chord of an arc is equal to twice the natural sine of half the angle, and as the tables are computed for a radius of 1, and our radius is 6, we multiply the sine given in the table by $12 = (6 \times 2)$ for the required diameter in inches. Thus, in either Haswell's or Trautwine's table of natural sines, under 15°, which is half the angle, is .258819°, which $\times 12 = 3.105828$, or 3.106 inches diameter required. The diameter to bore the outer flange is evidently $12 + 3.106 = 15.106$ inches.

As this principle is of universal application, and, while old, may yet be unknown to many who would like to use it if they only knew how easy it is, to help them is my excuse for describing it in detail.

CHARLES S. BEACH.

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Ball Turning.

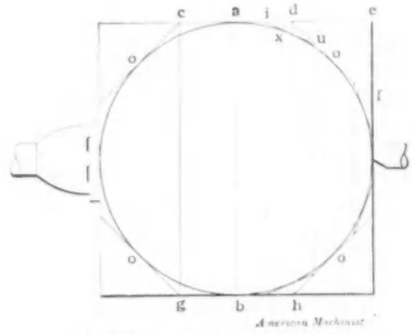
Editor American Machinist:

Since the trouble between the United States and Spain began many corporations as well as private individuals have shown their loyalty by erecting flag poles and hoisting the Stars and Stripes. Generally those who do so want the pole crowned with a ball, which has to be turned by somebody. Now, when the pattern-maker or other workman receives the order to make the ball something conforming to a true sphere is required, and not a thing of the pumpkin variety, either oblate or prolate. About the simplest way to do it that I know is indicated by the sketch. After turning the block to the right diameter and having the length squared to correspond, which will give us a cylinder the length and diameter of which are equal, our next move is to turn off the corners at an angle of 45°, as seen at *o o o o*, which faces are then tangent to the outline of the ball. To know just how much to cut away so that the successive faces that may be needed will be just right, and so that after such faces are made all that is left to do is to case off the different angles by no other guide than the eye, is the object of this letter.

Assuming that a center line *a b* has been made, we find the distance required to lay off each side of it by multiplying the radius by the decimal .4142, which gives points *c* and *d*, then the distance from either of theses points to the end of the cylinders, as *d e*, gives the distance *e f*, where a ring must be marked on each end. Then if we are careful to turn the face off flat and straight to these marks, the work should be the right size across the corners. Now, we want to know the proper amount to take off points *c d f*, etc., to change the form from eight sides to sixteen. To do this multiply the decimal .1989 by the radius of the ball, and that gives the distance to measure each way from the angles *d f*, etc. This gives us all that is required to shape such a ball as here shown, but should it be 10 inches or more in diameter it may be advisable to take another decimal, .0991, and by using the same multiplier as before we have the means at hand to give the work thirty-two faces, which I believe will be sufficient for any ball we are ever likely to produce for tops of flag poles.

Oneonta, N. Y. WM. NEWTON.

[The several multipliers used by our correspondent, .4142, .1989 and .0991 (the last more correctly .0985), are the natural tangents, to radius 1, of the angles 22° 30', 11° 15' and 5° 37½', which are halves of the angles 45°, 22½° and 11¼° of the polygons of 8, 16 and 32 sides respectively. These multipliers also represent



TURNING A WOODEN BALL.

correctly the halves of the sides of the several polygons to radius 1 of the inscribed circle. The first is therefore used correctly, as it actually measures the tangent of the inscribed circle. Those used subsequently cannot give a correct result, as they are used upon larger radii, but are doubtless sufficiently accurate for the special job designated. Referring to the diagram, the line *i u* must be shorter than *d i* + *d u*, although the latter is the actual length which *i u* should have.—ED.]

▲ ▲ ▲

Loose Pulleys and Their Lubrication.

Editor American Machinist:

No matter how old the loose pulley device or how big the barrel of ink that has been consumed on this subject, the right remedy has not yet been applied. The discussions in No. 26 and No. 30 of the "American Machinist" agree in two points, namely: To provide large bear-

ings upon the shaft and to furnish sufficient lubricant at all times. It seems strange that these conditions cannot be satisfied, but it is the inclination of machinists rather to produce patentable devices to eliminate bad conditions than to go to the root of the trouble. It is inexcusable to make the bearings small and other than central to the face of the pulley. The result of using the one-sided pulley is a greater wear on one end of the hole and on the shaft at the same point, running up to a premature repair of the loose pulley and replacement of the shaft.

The lubrication problem can best be solved by hollow shafts; in fact, drawn steel tubing is the ideal for future shafts. The ends of tubes closed by screwcaps so that oil is retained and may also be renewed when consumed, a number of fine cross-holes drilled in the shaft at places where hangers and loose pulleys come should eliminate the existing troubles successfully.

It is evident that the want of oil and unequal strain upon the shaft must lead to ruin, and these conditions are not duly considered in commercial countershafts. The introduction of the slow feeding oil-cup has done more good than it is generally given credit for, and its present low price will secure a lasting place for this device; but there are places where it certainly ought not to be used, and the loose pulley in many cases is one of them. Grave objections to hollow shafts seem hardly in place in view of the rapid progress made in their production, and to improve the existing solid shafts and spindles the lathe and drill are always at hand.

E. MOTCHMAN.

Bellefonte, Pa.

▲ ▲ ▲

Educate the Boys.

Editor American Machinist:

The letter published in your issue of July 21, and the editorial of the same date, both with the heading "Educate the Boys in the Shop," call attention to one of the most serious and perplexing problems of modern civilization. This problem was forced upon my attention not less than forty years ago, and by conditions then apparently more hopeless for the boys than in the screw factory now cited. There was, at the time I speak of, a village in Northern New York whose one industry was iron and whose specialty was cut nails. The nails were made from iron plates rolled of a width equal to the length of the nail to be produced, and the machines bit off each nail separately from the end of the plate, automatically performing the subsequent operations and discharging the finished nails. The plates, which were heated, were required to be turned over after each nail was cut off, to compensate for the taper of the nail. In those days no practical nail machine feeder had been invented, and so all the feeding was done by boys. The plates in feeding were turned over, pushed in as far as they would go, and also set sidewise against a gage, and the machines were run as fast as the boys could feed them. The only breaks in the monotony of the operation were in attaching the tongs to a new plate as each preceding one was used up. The plates were from 18 inches to 2 feet long. The work was not only monotonous, but it was also hard work, and there were several rooms in each of which a hundred or more boys were thus employed all the year round, and there was no prospect in that village of any other employment for one in ten of those boys. Various changes have come over the nail business. Mechanical feeders have thrown out all the boys, and the cut nails have been largely superseded by wire nails.

Within the present year I was in a wire mill where I saw another operation for which boys were employed, and with little chance of promotion to anything better. In the rolling of the rod for the wire, before the drawing begins, the rod is sometimes passing through two or three pairs of rolls at once, and as a constant elongation of the rod must occur between each successive pair of rolls boys are employed to hook into the loop and keep it extended and prevent kinking or tangling. This work was not hard and the intervals of rest were longer than those of action, but here also there was small prospect or possibility for change of occupation or for advancement in the establishment. The operation here intrusted to the boys was one not impossible or unlikely to be accomplished by mechanical means later on, and there may be the same ultimate emancipation for these boys as for the nail machine feeders. This process of emancipation is going along all the while in all manufacturing operations, and is not to be lost sight of if we are disposed to be too anxious or too hopeless about the future of the boys.

I had extensive and protracted and perplexing personal contact with this problem of employment and advancement for the boys as foreman of a machine shop all through the eighties. The shop with which I was connected was run of course for the purpose of making money, and the purpose was accomplished right along. A large part of the business was in pulleys, hangers, couplings, collars and everything pertaining to shafting. Quite a number of boys were employed all the while, ostensibly to "learn the trade," actually to get out the work. My business, of course, was to keep the work going and to get out as much of it and as cheaply as possible. Well, the several operations involved in that line of work were soon learned, and then the work of course became monotonous for the boys, but what could I do? The worst job, probably, was boring and turning cast iron collars, and we turned them out by the hundreds of each size, and they had to be done. The boys used to get very sick of them. I never had the least trouble with lazy boys, and I believe they are rare, if they only have half a chance, but they would kick about turning the collars day after day and week after week, and I certainly had no respect for them if they did not kick. But, notwithstanding the kicking, there was little that I could do to give variety of work and work calculated to develop skill and judgment, and I was, I believe, as dissatisfied with the situation as the boys were. I have no doubt that a great many foremen have had the same experience, and must continue to have it, and there is very little that they can do to change the order of things.

This curse of monotonous, unprogressive and uncongenial employment is no new thing, and bears its weight neither more numerously nor more heavily than it always has. We have only to go back to the days before the power loom and the sewing machine, not to mention the numerous other instances, to find larger classes tied to hopeless and lifelong drudgery.

The problem of the boys, and of the men and women, too, is encountered on every hand and in connection with all manufacturing operations. The way out is not altogether, if at all, by the application of the lifting process. The boys have to climb out, and they are continually doing so, and the most promising thing to do for them is to stimulate their climbing propensities. The boys that I was troubled about less than a score of years ago have kicked themselves into respectable and comfortable positions, and are not now thanking anyone to fret about them. Technical education is a great help, but general education is more important. "Educate the boys in the shop" by all available means, but "educate the boys" is the only sufficient and complete solution.

TECUMSEH SWIFT.

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Corn as a Substitute for Coal—Ash in an Internal Combustion Engine—A Single Piston Valve.

Editor American Machinist:

In your July 28 issue the writer who proposes the use of powdered corn as a fuel for an internal combustion motor fails to take cognizance of the insurmountable difficulties common to the use of solid fuel of any kind in such a motor. The ash of corn being abrasive is a considerable percentage of the substance, and unless it is removed from the cylinder walls will soon cut them, requiring renewals very frequently; so much so, in fact, that the up-keep would be greater than the first cost in a short

time. A better way—if corn is cheap enough to be a fuel—would be to use it in a fuel gas generator and use the resultant gas in the motor. Another thing: The deposition of unburned carbon from solid fuel under such conditions is quite large, so that very frequent cleaning of the cylinders would be necessary to avoid clogging up ports, etc.

While on the subject of gas engines, I would like to state that in 1897 the writer designed a two-cycle gas engine for the Sawyer & Massey Company, Hamilton, Ont., using a single piston valve, and to the best of his knowledge is not aware of it being previously used. Would like to learn if the piston valve has been used in that connection by any other manufacturers. J. B. HALL.

Auburn, N. Y.

[By conversation with the writer of the article referred to by Mr. Hall, we found that he did "take cognizance" of the difficulty referred to, but he claims that it is far less serious than is generally supposed, and that, in fact, if the fuel is sufficiently pulverized and thoroughly mixed with air the trouble from ash in an engine specially designed for such service would not be by any means insurmountable. Whether he is right about that or not could probably be determined only by trial.—ED.]

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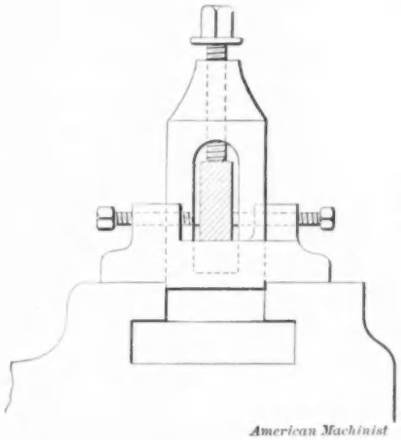
Holder for Boring Tools.

Editor American Machinist:

The inclosed sketch shows how boring bars or tools may be rigidly held in the slot and set screw type of tool post. Incidentally it admits of adjusting the bar with ease and accuracy. The rig consists of two pieces for the bar to rest on that are notched into the tool block and turned up at each end and tapped for set screw. These pieces take the place of the usual ring. The screws are set up against the side of the bar fore and aft of the tool post, and effectually prevent the bar from swinging around in the post. The sketch is an end view of rig looking toward face plate of lathe.



HOLDER FOR BORING BAR.

J. H. DUNBAR.

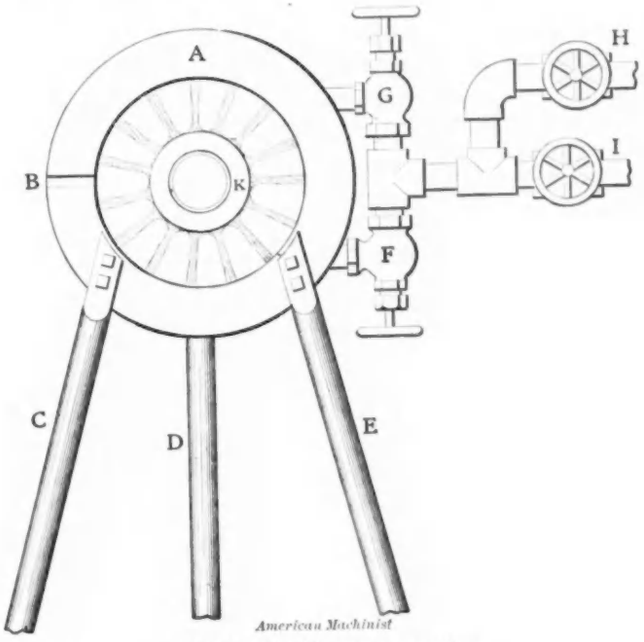
Youngstown, Ohio.

▲ ▲ ▲

A Brazing Rig.

Editor American Machinist:

This is an application of the well-known Bunsen burner principle and it has won favor in a number of locomotive shops. Being light and portable it has the advantage of being easily carried about and used wherever wanted. The ring *A* is of cast iron cored out, and is separated at *B*, as shown, probably for expansion. The internal chamber is divided by a wall into two parts, each of which is connected by right and left pipe nipples to the valves *F* and *G*. The air and gas are connected at *I* and *H* and the proper mixture secured by adjusting the valves shown.



A GAS HEATER FOR BRAZING.

The ring *A*, which is about 9½ inches outside, 6½ inches inside and 4 inches wide, has fifteen rows of 3-32-inch holes drilled on the inside for the escape of the burning mixture. This is conveyed directly on the work shown, which is supposed to be a collar, *K*, to be brazed on a pipe.

Although a very intense heat is obtained firebrick are not required, as no part of the apparatus is exposed to the direct action of the flame and continued use will not heat it up to a degree that is injurious. By means of the two valves *F* and *G* the degree of top and bottom heat can be nicely regulated and the best of results obtained.

The leg *D* is jointed at the back, so that the whole thing can be laid over at an angle on work that may require it.

An improvement which might be useful on some classes of work would be to have the ring *A* jointed opposite *B* and provided with the proper pipe conections. Then work like closed coils, etc., could be easily handled. FRED E. ROGERS.

Corning, N. Y.

▲ ▲ ▲

Pipes and Fittings.

Editor American Machinist:

It would be easy to believe, on the visible evidence, that the one perfect and fully complete thing in mechanical practice is our system of wrought iron piping and the fittings that go with it. If any improvements have been made in this line within a generation, or, say, since the civil war, it would not be easy to say what they are. I cannot think of anything, at least so extensive and important, in which there has been so little change as here. Not only has there been little change, but there has been also little suggestion of change, and comparatively little recognition of the great chances for improvement in piping material and practice. And yet it would not be difficult to enumerate many particulars in which our piping practice is far from satisfactory, and in which it is not comparable with the excellence and perfection attained in collateral branches of engineering.

Piping is cheap enough. There is no occasion for much fault finding on that score, if anyone is able to understand all the mysteries of the discounts, which I confess I am not. In a recent market report I saw a list of wrought pipe with discounts of from 50 per cent. to 67 per cent. for the different sizes, and then "extra six 10s." I understand from that that you take the list price, first take the main discount of 50 to 67 per cent. from

that, and then from the remainder take 10 per cent. successively six times. If I have done my arithmetic correctly this makes the net prices of pipe, as referred to above, 23.9 per cent. and 15.77 per cent., respectively, of the list price—less than one-quarter and one-sixth. Piping is cheap enough as it is furnished, and is altogether too cheap as compared with what should be furnished. This applies rather to the valves and other fittings than to the pipe itself. They are too light, so that sometimes they actually will not stand the pressure required, in many cases they spring out of shape, and the screws, valve faces and seats and other working parts give out in a very short time, so that the whole thing has to be renewed. Cheap fittings entail large expense in repairs and renewals, as well as in damages from accident, and cause numerous fatalities. They should not be as cheap as they are.

Piping is also too cheaply connected and applied. In the growth and development of the pipe system the apparently supreme things to be secured have been, first, the actual cheapness of the material, and second, the quickness and facility of putting together. Ten minutes of the pipe-fitter's time is of more importance than the ten or more years of the subsequent service of the pipe, and we can boast of wonderful, if not shameful, success in saving the ten minutes. The pipe tongs that are used are a barbarous outrage. They mutilate the outside of the pipe or crush it out of shape almost invariably.

Piping is a wonderful example of cheap interchangeability, not by good fits anywhere, but by the use of tapers that are bound to fetch up somewhere. There may be a dozen threads on the end of the pipe and a couple of dozen in the coupling, but the responsibility of the joint is all on one or two threads, and when the pipe gives out, except by freezing up and splitting, we expect and know that it must always give out at the threaded joints long before the body of the pipe is used up.

Pipe couplings are a beautiful example of how easy the mechanical world may be satisfied upon some points, when it splits hairs so fine upon others of vastly less importance. It requires only common sense to tell anyone that a pipe through which anything is to flow should have as smooth and continuous a surface within as possible. Instead of this we have a break of the continuity at every coupling, the surface neatly V grooved to help it hold any sediment or obstruction. Such a thing as butted joints is, of course, not to be thought of, although easy enough of accomplishment, because it would cost something. If the joint was made by the perfect butting of one end of a pipe against another end, the entire screw thread of both pipe and coupling would be at once free from liability to rust, but then we must have straight threads on the outside of the pipe and in the coupling, and a different kind of interchangeability from that which now prevails.

Then, as iron piping is now used for so many different purposes, why have we not also a good internal coupling for pipes, so that we could use it for fencing or railing without doing such outrage to the feelings of humanity. I suppose there are a couple of hundred miles of piping used for railing along the line of the Manhattan Elevated Railway in New York city alone, and it is all made of pipes and standard pipe fittings, with the couplings wherever they happen to come, because the pipe makers produce the pipe too cheaply to be able to measure and cut it off to any standard length, and the railing is as ugly as anyone could produce by deliberate trying. Iron piping could be made into handsome railing, but we never see the handsome, and we always see the couplings.

There are plenty of other bad things about our piping system which it is not worth while to mention, because everyone knows and nobody cares about them. Next to the couplings come the elbows. They also have the vicious enlargement of the passage the same as the coupling, but perhaps not quite as bad, because the interior is usually smooth. The short, sudden and jerky movement of the fluid through a standard elbow, and especially a liquid, and particularly if traveling fast, can hardly be called flowing without a perversion of language. Elbows of larger radius are provided, but they seem to find little favor, because they cost a little more, so that the fault in this case, and perhaps generally all through, is rather with the users of the pipe than with the makers of it. A better practice, of course, is to avoid elbows and make long bends in the pipe; but this is still more costly, or, what is worse, more troublesome, so that this is seldom done, even when highly imperative. Only a few weeks ago an experienced steam engineer, who knows well the details of his business, showed in one of the papers a sketch of what he said was the best way known to him for piping to the water gage glasses on the front of a boiler. The piping, as I remember it, had three or four standard elbows on it. Why, in this case, would it not have been still better to have avoided the elbows and used instead long curves in the pipe, so that it would have been possible at any time to free the pipe of sediment or obstruction by running a flexible rod or wire through it?

It must be evident to anyone who stops to give it a moment's thought that in the particulars suggested, and in many others there is loud call for improvement. Cheapness seems to be the present most disgraceful feature of our piping practice, and our complacent acceptance of it seems to indicate that there is little improvement in sight. If we were not so generally satisfied with things as they are it might be better all around.

TECUMSEH SWIFT.

▲ ▲ ▲

A Talk on Brass Founding.*

BY CHAS. VICKERS.

Yellow brass is the metal generally used for plumbing goods, and the patterns can be carded, namely, attached to match plates or boards, or else "gated," that is, a sufficient number of patterns to fill the standard size of flask are riveted or soldered to the gate, practically forming one pattern. It is better to put the patterns on plates whenever it is possible to do so. Bibs and cocks with their component parts, and globe and other valves, the parting lines of which are straight, can be all made by the match plate system. First-class flasks should be provided and kept in good condition. Interchangeable flasks are almost a necessity on plate work, as the plate must fit on the pin halves of flasks, which are used as nowels.

A yellow brass called dipping metal is generally used for chandelier castings. This class of work is mostly light and ornamental in character. Much of this work is skin dried by spraying with gasoline and then burning off. There is quite a knack in pouring, as the metal must be thrown into the mold with force enough to run and at the same time not strain the casting.

No branch of the foundry business calls for more individual skill on the part of the molder than that of machinery brass work. Not only must the workman be equally at home on floor or bench, but he must be prepared to turn out castings in a dozen different alloys, each of which has its own peculiarities in changing from the liquid to the solid state. Some alloys, as for example phosphor bronze, require the mold to be rammed more than ordinarily firm, while in the case of aluminum bronze we must go to the other extreme and ram it exceedingly soft, so that the mold will not resist the excessive contraction, otherwise the casting will be drawn apart. Phosphor bronze shrinks but little, but if poured too hot it will eat into a green sand mold almost like water; to prevent this it is poured cool into such molds. It can, however, be poured hot, provided the mold is well coated with plumbago and then baked before casting.

On small, loose jobbing work, when there are more than a dozen pieces required, it will pay to make "set" gates, as they save the time consumed in cutting and slicking the gates, besides producing cleaner castings. They are easily

* Presented at the Cincinnati meeting (June, 1898) of the American Foundrymen's Association, slightly condensed.

made as follows: Make a mold, cut the gate as required, leave the patterns in, close the cope and pour in tin at a low temperature, so as not to injure the patterns if they are wood. Should there be any castings previously made draw the patterns and substitute the castings, before closing and pouring.

In making heavy brass work it is advisable, whenever the shape of the pattern will permit, to pour from the bottom exclusively. Take, for instance, a brass bushing weighing, say, over 500 pounds. Suppose the pattern is 18 inches in depth, 3 or 4 feet in diameter and anywhere from 1½ to 2 inches in thickness, and has a green sand core in the center. The casting had better be poured with two pots, and gate at the bottom through runner cores. When the metal will impinge on the green sand core a piece of dry core is built in to prevent scabbing. The runner which leads the metal from the joint to the bottom of the mold should be about 1 inch in diameter. From the joint up, through the cope, it is enlarged to between 2 and 3 inches in diameter; thus we get metal to feed and keep the gate solid. A so-called skim gate is used in pouring. About 4 inches distant from the aforesaid runner, with its riser, another runner cuts through the cope to the joint; it is connected to the riser of the first runner by a horizontal channel cut in the cope. This channel must taper from the runner to the riser, like a nozzle. It is comparatively small at the junction with the riser. Here is the point where care and judgment must be used. If it is too large it will take the metal too fast, making it impossible to keep the pouring head full, and the scum will enter the casting. If it is too small it will not take metal fast enough, and the casting may not run, as it is poured rather cool. As the pots empty the stream naturally grows smaller; this is another point to be watched, or the head may sink and the whole of the bubbly scum be sucked into the mold. When the head is successfully kept full this method of gating gives clean castings.

In order to feed and prevent shrinking in the casting we have been considering it is prudent to put on a riser 3½ inches in diameter. It must not be put on top of the casting, but about an inch away from it anywhere convenient, connected with the casting by a good, deep gate, filleted so as to break off hot, without breaking in. Carry the feeder up 4 inches above the cope. When the mold is filled cover the pouring head and the top of the runner riser with sand, bed on a weight, then fill up the feeder head. Shake out while hot, break off feeder and runners, and scrub the casting with a spade.

It is very seldom that the practical metal mixer gets a chance to use wholly new materials. The scrap brass must be used up somewhere, and it is generally cheaper than a new mixture. To use it judiciously is where the art of metal mixing comes in. The mixer must be able to judge of the quality of the metal in the different pieces of scrap. Bells, bearing brasses and bushings are generally hard brass. Car brasses justly come under suspicion; they are often made of old copper buttons and scrap containing iron. They must be used sparingly in finished work. Valves and small red brass scrap are generally soft and may be used accordingly. Soft brass may be stiffened by the addition of hard scrap, and porosity guarded against by adding yellow brass scrap. Scrap metal has a great tendency to make dirty castings; guard against this by cleaning the metal before pouring. Bring the metal from the furnace hot; add the new metal mixture. After stirring thoroughly scrape down the sides and bottom of the pot, inside, with the skimmer, which had better be of five-eighth-inch round iron; stir again and skim off. If the metal is hot enough there may be time to repeat the stirring and skimming. A surprising quantity of dirt is removed from the metal in this way. When pouring bridge the lip of the pot with the skimmer, holding back all dirt. The writer has made key heads, scaling 30 pounds each, with only one-sixteenth-inch stock allowed on both sides for finishing, out of common scrap, by using care as aforesaid, and not lost one out of sixty.

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A Large English Gas Engine Contract.

A contract was recently awarded by the Main Drainage Committee of the London City Council for eight gas engines, four of them to be double cylinder engines of 210 indicated horse-power each and four of 260 horse-power. The price for the lot was £10,387 ($51,935) for manufacture, delivery and erection.

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The following paragraph recently appeared in a Welsh local paper:

"Tradesmen in St. Mary street, Cardiff, have lost a lot of time lately by standing on the edge of the pavement and expressing their appreciation of the borough engineer's new system of hydrostatics. The water tables are constructed on a parabolic plan that quietly invites the surface water to run up hill. As the water will not accept the invitation it stays still and stagnates, and the hydrogenated effluvia that march into the shops are so powerful that the tradesmen have to chain everything movable to the counters, while their endeavors to utter remarks appropriate to the occasion are positively distressing and worse."

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Locomotive No. 99, recently retired from service at Grafton, W. Va., had an eventful history. It is one of the Ross Winans camel-back engines, built in 1851. During the civil war this engine was one of several captured at Martinsburg by the Confederates, and hauled across the country to Staunton, Va., Col. Thomas R. Sharp directing the work. After the war President Garrett, of the B. & O. road, hunted up Col. Sharp, and appointed him master of transportation in recognition of the ability displayed on that occasion. It would seem that such an engine should not be reduced to scrap, but might better be placed where it may be seen by those of the present and future generations who are interested in the history of mechanical things.

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In a reply by the Union Iron Works, of San Francisco, builders of the Oregon, to a congratulatory letter from Secretary of the Navy Long the following occurs:

"American designed and American built, she has offered a new lesson to older nations regarding the functions of a battleship, and we are proud in the fact that under the most trying circumstances it has been demonstrated, to your satisfaction and approval, that ou contract has been well and conscientiously performed. But with all this, we believe that much of the success of all vessels is based on their intelligent handling by their skilled officers, subordinates and men, without which their usefulness would be greatly impaired, if not wholly destroyed."

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It is announced that, as a result chiefly of experience gained in the naval battle off Santiago, the plans of the three new battleships, which had been authorized by Congress, will be changed. They are to be made larger and faster, and Congress is to be asked to authorize the additional expenditure. The new plans contemplate ships of 13,000 tons displacement, 18 knots speed, and with 8 and 12 inch guns instead of 6 and 13 inch, as at first intended. It is thought also that the entire bottoms of the new ships will be sheathed with copper, with a view to preventing attached marine growths and falling off in speed.

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By the report of the chief of the Bureau of Industrial Statistics of Pennsylvania, the year 1897 seems to have furnished a new record in the manufacture of finished forms of iron and steel. In Pennsylvania alone 4,714,333 net tons of steel were rolled. The average value per ton of the output in 1896 was $31.68; in 1897 it was $26.28, a shrinkage of 17 per cent. The number of employed was 56,702, an increase of 3,129. The average number of days worked was 269, an increase of 18 days. The average earnings for the year, skilled and unskilled labor, was $468.73, an increase of $23.84.

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Some Bicycle Experience.

There is some reason for the belief that the bicycle business has been seriously crippled by its own prosperity. The business is to-day in a condition which is anything but satisfactory, and this unsatisfactory state of affairs is undoubtedly due primarily to the fact that the desire of nearly everybody to own a wheel enabled the comparatively few manufacturers who were at first in the business to get prices out of all proportion to the cost of production, and thus tempt everybody into the business.

Several years ago, when wheels were listed at $150, there was talk of a combination. An expert examined the business of several establishments with a view to organizing a combination, and in one case advised the directorate of a leading concern to reduce its price to $75. They regarded him as a fit subject for an idiotic asylum, and said that a sufficient answer to such a wild idea was to be found in the simple fact that at $150 they were unable to keep up with their orders.

In answer to the questions of one director, who, however, seemed impressed, the expert stated that his advice was based upon the facts that $75 list would leave a good fair margin of profit, and that if wheels were so listed by the leading companies then in the business, it would prevent a bicycle factory being started at every crossroads in the country, and avoid a crash which he thought was almost sure to come. He took the view that a manufacturer looking for a permanent business should not exact more than a reasonable and fair profit; to do more than that was to invite disaster by stimulating extraordinary competition.

Events have proven that this expert was not so very wild as he was then considered to be. The cycling journals attempted to throw a halo around the art of making wheels, and told us, with much persistence, that prices were as low as they ought to be; that the cost of such "very fine work" was tremendous—far beyond anything conceived of by those who had not tried it. Some riders believed this, but no one well informed in mechanical matters did so, and people continued to invest their money in new factories, until it is now apparent there are far too many of them. It is a case in which vaulting ambition hath overleaped itself, and it remains to be seen whether or not the same mistake is to be made in the coming industry of making auto-vehicles. It is easy to show that, as compared with the loss of buying and maintaining horses in a city, a motor driven carriage is far cheaper, even at a price which is far beyond what the cost of production will warrant. But this consideration, while it will induce a purchaser to lay down his money so long as he can do no better, will have no discouraging effect upon those who have money to invest in new motor carriage factories. Experience is a great teacher, but its lessons must be heeded in order to get any benefit from them.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(85) B. D. S., Saginaw, Mich., has a cast iron wheel with a steel tire of the following dimensions: Outside diameter, 66 inches; bore of tire, 64½ inches; face of tire, 7 inches; speed, 500 revolutions per minute; weight of tire, 300 pounds. He desires to know (1) what would be the strain and expansion of this tire due to the centrifugal force. A.—By referring to No. 73 of this column in the issue of July 7 you will see that the formula for the strain on the cross section of a wheel rim due to centrifugal force is

$$F = \frac{W v^2}{202.319\ R}$$

in which
F = total strain on the cross section;
W = weight of rim in pounds;
v = mean velocity of rim in feet per per second;
R = mean radius of rim in feet.

The values of these quantities in this case are
$W = 300$;
$v = 142.4$;
$R = 2.72$.
Substituting gives

$$F = \frac{300 \times 20277}{202.319 \times 2.72} = 11{,}050 \text{ pounds.}$$

The cross section of the tire is $7 \times 1\frac{1}{4} = 8.75$ square inches, giving

$$\frac{11050}{8.75} = 1263$$

pounds strain per square inch.
A steel bar 1 square inch in cross section will stretch $\frac{1}{30{,}000{,}000}$ th part of its length for each pound of load applied. Hence this tire will stretch circumferentially, when loaded with 1,263 pounds per square inch,

$$1263 \times \frac{1}{30{,}000{,}000} \quad \frac{1263}{30{,}000{,}000} \text{ths}$$

of its length, and since its length is 205 inches the total stretch will be

$$\frac{1263 \times 205}{30{,}000{,}000} = .00716 \text{ inch.}$$

This stretch being circumferential the increase in diameter will be

$$\frac{.00716}{3.1416} = .0023 \text{ inch.}$$

(2) What will be the expansion if the tire is heated 100° Fahr. by friction? A.—The coefficient of expansion for steel is about .0000065. Multiplying this by the circumferential length and by the number of degrees increase of temperature gives

$$205 \times 100 \times .0000065 = .133 \text{ inch.}$$

The increase in diameter due to this increase of length is

$$\frac{.133}{3.1416} = .042 \text{ inch.}$$

You will see that the effect of the centrifugal force is trifling, both as regards strain and stretch, but that the expansion due to heat is more serious. Both these actions take place on the wheel center as well as the tire, and partially neutralize the effects on the tire. Cast iron (contrary to the usual belief) stretches more than steel with a given load, and if the spokes could be ignored the fit would get tighter with increase of speed. The heat would also penetrate to the wheel center and so expand it. If your tire is shrunk on with the allowance specified by the American Railway Master Mechanics' Association—.07 inch for this diameter—we should expect the wheel to be safe in all respects.

(86) W. V. D., Melbourne, Australia, asks (1) What is the rule for determining the capacity of an air receiver to suit a compressing plant of given size? A.—A common size of air receiver for rock drill plants is 4 feet diameter by 5 feet long, giving 188 cubic feet capacity. This size of receiver is suitable for about 15 drills,

which at 70 cubic feet each consume 1,050 cubic feet of free air per minute, $\frac{188}{1050} = .18$, so that the volume of the receiver is a little less than the displacement of the air compressor piston during eleven seconds of time. This seems very small, but it serves to emphasize the fact that it is impracticable for a receiver to do much more than provide for momentary fluctuations in demand. As a reservoir of power its capacity is and must be small. (2) What proportion exists between the free air capacity of air compressors and the water necessary for the cylinder jackets? A.—There is no rule. In the test of a compound compressor published in our issue of April 16, 1896, one pound of water was supplied to each 11 cubic feet of free air. This water was put through the two jackets and the intercooler in succession, and the rise in temperature was 4° Fahr. in the low pressure jacket, 3° in the high pressure jacket and 150° in the intercooler. So far as the jackets alone are concerned, one-half or even one-third the quantity of water would have made no material difference in the performance of the machine. The jacket water does little more than keep the machine cool—as an economic factor its value is very small. (3) What is the rule for the volume of the intercooler to avoid excessive variation of pressure? A.—There is no reason why the rules for compound engine receivers should not give sufficient volume. In point of fact, however, with the duplex type of compound compressor and the arch type of intercooler, if the air is placed outside the pipes, as it should be, the volume will usually be ample without special attention. (4) What is the rule for the proportions of the cooling surface of the intercooler? A.—There are but few published data on this subject. The compressor above referred to had 1 square foot to each 10½ cubic feet of free air passed per minute during the test, and the air left the intercooler 20° warmer than the leaving water. This result is scarcely satisfactory. We consider that the allowance of surface is, however, ample if the arrangement is correct. With the arch type of intercooler having the air outside the tubes, fitted with partition plates to compel the air to cross and recross the tubes, and with the air and water passing through in opposite directions, the proportions named should give good results. (5) How is the quantity of water necessary for the intercooler calculated? A.—As stated in reply to (2) the water passed in the test referred to was one pound to each 11 cubic feet of free air, and the rise in temperature of the water in passing through the intercooler was 15° Fahr. This is probably as small an amount of water as should be provided. The following additional data obtained from that test are useful for determinations of this kind. Of the heat produced in the low pressure cylinder, 14 per cent. was absorbed by the jacket, and of that produced in the high pressure cylinder, 15.6 per cent. These figures were, however, obtained at only 52.2 revolutions per minute—much below the normal working speed. The amount of heat absorbed by the jackets would probably be not far from constant at different speeds, and of course the percentage so absorbed would diminish with the speed. Of course, too, the heat absorbed by the jackets of a compound compressor would be greater than in those of a simple machine. The absorption of heat by the low pressure jacket was at the rate of 28 B. T. U. per square foot per minute, by the high pressure jacket 30, and by the intercooler 14.8. The apparent superior efficiency of the jacket over the intercooler surfaces was probably due to the greater average difference of temperature between the air and water, although in view of the fact that the hot air is presented to the jacket surfaces but one-half the time, so great a difference in this respect would not be expected.

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Coal in Naval Warfare—Its Importance on Board Ship.

Next to the men who man a modern naval vessel, coal is the most important thing she carries. Without it she is lifeless and useless, and many an anxious time is experienced when figuring the relation between the estimated amount of coal in the bunkers, the distance to the objective point or a coaling station and the rate of coal consumption at the desired speed, and the orders as to speed are sometimes found to be totally inconsistent with the coal supply.

A writer who has evidently seen something of such matters gives an interesting account in "The Sun." He says:

Coal is the bugbear of modern ships of war. It is the cause of ceaseless bother fore and aft. Coal gets the nerves of fleet commanders, ship commanders, chief and assistant engineers on edge for long cruises at a stretch. Coal, which also means coaling, causes more desertions from the navy than any other feature of the service. The growls over coal and coaling aboard men-of-war of to-day are never ending. When the potency of coal for rendering chief engineers half insane is considered it is no wonder that so many of them go to pieces physically and are forced to retire when they ought to be in their prime of usefulness.

Ever since men-of-war were first driven by steam the world's navies have been experimenting with coal. The results of their experiments up to the present time, as most of the chief engineers confess, may be represented by naught. The steaming radius of a ton of coal, the weight of a ton of coal's smoke, the weight of a ton of coal's refuse, the proportionate amount of clinker in each and all of the world's brands of steaming coal, the number of pounds of steam made in a given time by each and all of the world's brands of steaming coal—these and about forty others of similar character are the minor problems that come in for solution after the chief problem of getting aboard enough coal to drive the ship a specified distance is solved. These are the pencil and pad puzzles that conduce so to the conversion of naval engineers into neurasthenic wrecks.

The big problem of course is the consumption of coal—the getting of enough coal aboard a man-of-war to drive her through a certain number of leagues of water. Coal is deceiving and treacherous. It has an utterly inexplicable fashion of working its way into the furnaces, of sneaking out of bunkers and of smashing the calculation slates of skippers and engineers to smithereens. Many an innocent coal-passer on board a man-of-war gets himself dragged up to the mast to explain to his skipper and chief engineer the absence of a certain amount of coal that ought still to remain in the bunkers the coal heaver has been working in, but that isn't there all the same.

Coal-passers have been worried into saying, "I didn't eat the coal," under these cross-examinations. When coal consumption calculations are spoiled in this way, the recrimination that follows all along the line is natural. The skipper says the chief engineer hasn't a properly developed bump of economy. The chief says the men have sneaked the coal into the furnaces. The men say the coal is no good and burns like dry hemp. And the coal goes right on using itself up as if bewitched.

Chief engineers know, of course, just how much coal the bunkers of their ships will hold, to a pound—in cubic measurement—but figures lie with reference to coal. When a chief midway on a cruise wants to know how much coal he has used and how much he still has on hand, he never simply subtracts the amount used, according to the log, from the amount taken aboard at the outset of the cruise. He knows that if he does this he'll probably get his ship into the trough of the sea 400 or 500 miles from land without a pound of coal left to move her into port. He first sends his yeoman, a chief petty officer, into the bunkers to do some figuring. He discounts the yeoman's report through his knowledge that all yeomen are optimists and therefore likely to tack on a good many more tons than the bunkers contain.

After the yeoman has washed up and made his pen and pencil sketch of the bunkers, with the figured amount of coal remaining in each of them, the chief sends one of his cadet engineers through the bunkers for a report on the amount of coal remaining on hand. The cadet engineer does some fancy figuring, making his calculations as abstruse as possible for the greater effect of them, and then the chief has one of the assistant engineers undertake the murky, smutty trip through the bunkers. The assistant engineer's figures occasionally get within 100 tons or so of the figures presented by the yeoman and the cadet engineer. Finally the chief assumes the blue jumpers and blouse himself and makes the bunker cruise. He always emerges from the bunkers with a gloomy eye and with his confidence in the three officers he has sent through the bunkers quite shattered, and he generally makes for the captain's cabin and announces that if the speed of the ship is not immediately reduced he won't be held

responsible for the ship's running out of coal in midocean.

The perturbation of the chief engineer under these circumstances usually works on the feelings of one of the old machinists at the throttle. These old machinists are practical, experienced men, who don't know much about figures and have no sort of reverence for cubic measurement. One of them goes through the bunkers, sizes up the amount of coal remaining in each of them by the simple eye method, which is the evolution of experience, and makes a report on the amount of coal on hand that in nine cases out of ten is proved at the end of the cruise correct almost to the ton. Thus the trouble over the coal in the bunkers is never at an end.

If the chief engineer's trouble over the question of coal consumed and on hand were the end of the problem it would not be so bad, but the number of reports he is compelled to make to the Bureau of Steam Engineering on each cargo of coal is appalling. He has to tabulate for the Bureau of Steam Engineering the exact amount of coal, to a half bushel, used daily for driving ship, for working the ventilating engines, for working the flushing pumps, for working the dynamos, for furnishing heat, for running the ice machines, for operating the condensers, for doing all of the things aboard a modern man-of-war that steam is employed for. He must see to it that every pound of refuse from the coal used on a cruise is measured and weighed and report on it. He must have the clinker assorted from the refuse, have it weighed and report on it. He must note the color of the coal's smoke and report on it at varying degrees of density. He must, in general, note the conduct and morale of all the coal consumed on his ship and report on it. No wonder that chief engineers on shore duty always look away when they pass a coal-yard.

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Our Export Trade.

The commercial relations of the United States are undergoing a marked and significant change, which may be said to have proceeded during the past twelve months at an accelerated pace. The United States is no longer the "granary of the world" merely. While its export of agricultural products has increased to a remarkable extent during the past year, its sales abroad of manufactured goods have continued to extend with a facility and promptitude of results which have excited the serious concern of countries that, for generations, had not only controlled their home markets, but had practically monopolized certain lines of trade in other lands. When it is considered that this result has been reached with comparative ease, in spite of added impediments to United States exports in the form of discriminations of various kinds, and notwithstanding the fact that organized effort to reach foreign markets for our manufactures is as yet in its infancy, the ability of the United States to compete successfully with the most advanced industrial nations in any part of the world, as well as with those nations in their home markets, can no longer be seriously questioned. The reports of consular officers present many striking evidences of the increasing popularity of United States manufactures, especially iron and steel labor saving machinery and tools, electrical supplies, locomotives, bicycles, etc., and notwithstanding the enormous gain in export of agricultural products, amounting to nearly $74,000,000 for the eight months ended February 28, 1898, as compared with the same period of the previous fiscal year, the percentage of exports of manufactures as compared with the total exports shows a decline of but 1.52 per cent. During the eight months of the fiscal year 1898 there was, in fact, an increase in exports of manufactures amounting to $6,474,245.

The secret of the steady advance of United States goods in popular appreciation wherever they are introduced is to be found in their superior excellence at little, if any, difference of cost to the consumer. The only thing lacking to enhance their acceptability would seem to be the special adaptation of the styles and patterns to the local requirements of a particular market. Until quite recently it was a common impression in foreign countries, as well as in the United States, that the higher wages paid in the latter would always operate to the disadvantage of our exporters in the competition for the sale of manufactured goods abroad. Actual trial, however, seems to have proved that, owing to the greater producing capacity of the average American operative with the aid of labor-saving machinery, the real cost of United States goods in many lines of manufacture is lower than that of similar products in European countries, and that the American exporter is thus enabled to meet his foreign rival on more nearly equal terms or even undersell him.

It is frequently asserted of particular industries in the United States that the output of factories working at full capacity is much greater than the domestic market can possibly consume, and it seems to be conceded that every year we shall be confronted with an increasing surplus of manufactured goods for sale in foreign markets if American operatives and artisans are to be kept employed the year round. The enlargement of foreign consumption of the products of our mills and workshops has, therefore, become a serious problem of statesmanship as well as of commerce, and this fact is evidenced in the steps being taken to negotiate reciprocal agreements with various nations, as well as in the important efforts being made by such organized trade bodies as the chambers of commerce of great export centers, the National Association of Manufacturers, the Philadelphia Commercial Museum, the export associations of New York, and other like organizations, to open new channels of trade as well as to improve the old ones. A practical advance in this direction of special significance is the recent establishment by the National Association of Manufacturers, at the capital city of Venezuela, of a warehouse for samples of United States goods. The Philadelphia Museum has already accomplished great good in its efforts to inform our manufacturers and exporters of actual trade conditions in foreign countries, and to instruct the latter as to the special merits of American goods. In all such enterprises the zealous co-operation of the diplomatic representatives and consular officers of the United States is freely given, and substantial improvement, under special instructions of the State Department, it is believed, has been effected in the character as well as in the volume of information which is constantly being obtained from these sources for the benefit of American industries and trade.

A. F. T.

Washington, D. C.

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Visit of Engineers to the Westinghouse Works.

Among the great workshops and the model shops of the United States are the works of the Westinghouse Machine Company and the Westinghouse Manufacturing Company at East Pittsburg, Pa., which were visited by an invited company of prominent engineers and others interested on July 30. The immediate occasion of the gathering was an exhibition of three 2,500 horse-power electrical generators, direct connected to three 2,500 horse-power engines built for the Metropolitan Electric Supply Company, of London, the greatest electric lighting company in Europe. While the sending of electrical apparatus to England is no new thing the sending of engines also is worthy of note. The London company to which these engines and generators are consigned is planing new central stations and newly equipping old ones, and it is likely that the Westinghouse Company will be called to supply much of the new plant.

The visitors to the works were also afforded an opportunity of inspecting the gas engine department, which is turning out engines from 10 to 200 brake horse-power in great numbers. The engines are especially adapted to electric lighting service. These engines, which use a modification of the Beau de Rochas cycle, compressing the charge in the head of the cylinder before igniting it, govern so satisfactorily that the company has built many direct connected rigs.

which give perfectly steady lights. The company has built an engine of this type of 650 brake horse-power. This engine has three cylinders 25x30 inches and runs at 145 revolutions per minute. It produces a brake horse-power (presumably per hour) with a consumption of 11 feet of natural gas.

Another most interesting exhibit to which the attention of the visitors was called was that of the Parson's steam turbine, now being manufactured. One was shown driving a 200 horse-power alternating current generator. The speed of the engine spindle was 4,700 revolutions per minute.

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The Brainard Milling Machine Company's Fire.

Editor American Machinist:

The notice in your publication of August 4 in regard to the fire at our works on the 24th ult. conveys a wrong impression, when saying that the plant was destroyed. Our wooden shops were seriously damaged, together with a lot of machinery, but our brick shops, which will accommodate over half our force, have continued running without interruption, our boilers and four steam engines being uninjured.

As we have an ample stock of most of the sizes of our machines, which, being in the storehouse, were uninjured, we are able to care for our customers with but little delay.

Yours truly,

BRAINARD MILLING MACHINE COMPANY.

Hyde Park, Mass.

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Technical Publications.

TEMPERATURE ENTROPY CHART. 11½x 18 inches. By Captain Sankey. Albert Frost & Sons, Rugby, England. Price 3 shillings

This chart is based on the water line and saturated steam line described by Mr. J. Macfarlane Gray in his paper on "The Rationalization of Regnault's Experiments." The chart embraces in graphic form all the physical properties of steam used in thermodynamics from 100° to 400° Fahr., and by its help thermodynamic problems can be solved and the temperature entropy diagram of a steam engine plotted from the indicator diagram.

We have received from the B. F. Sturtevant Company, Boston, Mass., a pamphlet giving an abstract of a lecture delivered at Cornell University recently by W. B. Snow, of the engineering staff of the above named company. We understand that this pamphlet is sent gratuitously to any address.

Personal.

Chief Engineer George W. Baird, U. S. N., has been ordered to continue his present duties as superintendent of the State War and Navy Department buildings in Washington, for one year.

Mr. Thomas L. Dates, formerly superintendent of the Detroit (Mich.) Brass & Iron Novelty Company, has resigned to become superintendent of the Gardiner Elevator Company, of the same city.

Mr. D. H. MacDonald, for six years chief draftsman of the Providence Steam Engine Company, has accepted the position of general foreman of the machine department of the American Ordnance Company, Lynn, Mass.

Mr. Geo. W. Lake, formerly general foreman of machine department, has been appointed general foreman of the American Ordnance Company's Lynn shops, the title of superintendent having been abolished, and that of general foreman substituted therefor.

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Tin, although a metal in common use, is sparingly distributed over the earth. The known gold fields of the world cover more than 1,500,000 square miles, while the tin fields have considerably less than 1 per cent. of that area, or 12,500 square miles. Africa has no known tin mine. North America has no paying mine, South America has but one tin field, and Australasia contributes but 6,000 tons a year.

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A by-product of one of the modern processes is corn oil. In the manufacture of glucose it is necessary first to extract the germ of the corn, and this has heretofore been wasted. In Chicago a company now ships 350 barrels of corn oil per day extracted from the germs by pressure, just as linseed oil is obtained. The oil, shipped in second-hand barrels, mostly goes to England for soap making, and rated at 3 cents per pound, is also used for cheap paints and is quick drying.

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A handy rule for approximately estimating the weight of water in a pipe is simply to square the diameter in inches, and the result will be the weight of the water in pounds for each yard of pipe. This rule is, of course, also applicable to circular tanks or cisterns if vertical. Thus the weight of water in a cistern 10 feet diameter and with the water 8 feet deep, will be $120^2 \times 2\frac{2}{3} = 34{,}400$ pounds, which result is about 5 per cent. less than the actual weight for water at 60° Fahr., but 3 per cent. more than the weight at 212°. As no rule of this character could be correct for more than one temperature, the rule is well worth a place in the engineer's handy book.

Commercial Review.

NEW YORK, SATURDAY EVENING, Aug. 6.

THE MACHINE TOOL MARKET.

We are contemplating the offer of a reward to anybody who can give us the name of a machine tool building shop that is not crowded with work. We have not lately heard of any such, nor have we heard of anyone who has heard. The out of town shops whose tools are sold through local offices are pronounced by those conversant with their affairs as hard at work. In Cincinnati everyone is busy, the following concerns being cited as examples: Cincinnati Milling Machine Company, G. A. Gray Planer Company, Bradford Mill Company, Bickford Drill & Tool Company, R. K. Le Blond, etc. The Lodge & Shipley Machine Tool Company, if our understanding of a report is the correct one, has now on hand orders amounting to 60 per cent. more than in any past year. Other Ohio concerns are very busy, to wit., the Springfield Machine Tool Company, the Morgan Engineering Company, the Ohio Machine Tool Company, the Niles Tool Works, which is rumored to have orders now on hand amounting to a particular figure not far short of a million dollars. Nor is the activity limited to the West. Brown & Sharpe Company, Pratt & Whitney Company, Beaman & Smith, all are hard at work. The Worcester manufacturers are so, in some lines at least. In that town Prentice Brothers, F. E. Reed Company, the Powell Planer Company and J. E. Snyder are favorably commented upon. In or near New York certain large concerns are well filled with orders. In Philadelphia Bement, Miles & Co. are said to be sold four or five months ahead. They are now running their Twenty-fourth and Wood street plant, which has not been in operation before for several years. Because the above names are reported it must not be inferred that others are not doing equally well.

The features of the machine tool market, as observed in New York sales offices, are as follows: July trade was not particularly active, but some concerns speak of it in very favorable terms, all things considered. From the latter part of that month, however, there has been an improvement in tone which is so widespread as to be very encouraging. The prospects of peace may have influenced it somewhat, although the actual peace negotiations are of too recent date to be credited with it entirely. Unquestionably the outlook is far brighter than it was at this time last year.

A considerable number of the machine tools being made in this country are, of course, for export. Certain shops are mentioned in which they amount to 75 per cent. of the output. At home a portion of the sales are for Governmental

purposes. In addition to metal working machinery some tool builders are executing gun carriage contracts. But withal there must be a very fair residuum of regular domestic trade. The exports of metal working machinery, which we give under a separate sub-heading, made for the fiscal year ending June 30 a total of $4,618,683. This is commented upon by sellers as a small showing, in view of the known strength of the export movement, and it is even questioned whether the statistics are complete. It is argued that, considering $1,000 worth to be the annual production of a workman, at 1892 figures, and allowing something for the present decrease in prices, this would represent the production of hardly 6,000 men. Schuchardt & Schutte alone are said to sell $2,000,000 worth of American machines in a year, and one American company is stated to have sold over $600,000 worth of tools during the fiscal year just closed through its own London and Berlin offices, though, indeed, they are not all shipped. Perhaps the explanation of the matter is that a few concerns have relatively a monopoly of the export business and that home trade is a more important factor in keeping the shops busy than it is given credit for.

The Continental bicycle machinery trade, like the American and the English, has had its day. French manufacturers of the wheels are undergoing a depression. The name is mentioned of one prominent French manufacturer not unknown in America who is suffering keenly.

Heavy tools are comparatively scarce. One company reports a great demand for boring mills of from 8 to 10 feet, and another, which perhaps has more influence in fixing the prices of boring mills than any other concern, has stiffened the rates considerably. Light tools are not, in most quarters, hard to come by, yet one important company, which sells some tools of other makes as well as its own, finds it difficult to obtain sufficiently early deliveries on 14 to 20 inch lathes and standard shapers.

Builders of large tools who cater to the railroads report that these are now buying little. This may be true of the Eastern roads, but the Grangers, such as the Chicago & Northwestern, the Milwaukee & St. Paul, the Rock Island and the Atchison are reported to be purchasing right and left all kinds of supplies, including iron and wood working machinery. Recent rains, which are said to have improved crops 30 per cent., will have an important bearing upon this department of the market.

Several tool sellers in this vicinity are figuring upon machinery to equip a shop for a railroad in Ecuador. Some $15,000 worth of machines are required, including large car wheel lathes, hydraulic car wheel presses, several car wheel borers, tenoning machinery, etc. Tool builders might profitably keep watch of a new road which is about to be constructed in Hayti, from Cape Haytien to La Grande-Riviere du Nord.

Some electrical shops are among those buying tools in this market. The Sprague Electric Company has been making purchases extending over a period of several months and distributed among a number of tool builders.

The Springfield Machine Tool Company writes: "Our new building, 60x175 feet, is approaching completion, which, as soon as finished, will be occupied and used as a foundry, and all the machinery in same will be run by electricity, namely: The blowers, elevator (for lifting iron and coke) and the rattlers. As soon as ready for operation we shall use our present foundry, brick building and frame addition for machine shop purposes, and the erecting floor will be used for additional machinery."

A concern having offices in New York lately received from Copenhagen an order for upward of $10,000 worth of iron working and other machinery. One firm was expecting to ship this week $20,000 worth of machine tools to Hull for reshipment to Russia. A consignment of $15,000 worth has just started for London. An order has just been received in this city from Genoa for three large metal working machines, besides some electrical supplies. Some believe that the Italian market does not receive the cultivation it deserves.

EXPORTS OF MACHINERY FOR THE FISCAL YEAR ENDING JUNE 30.

According to the "Monthly Summary of Finance and Commerce," exports of metal-working machinery for the month of June, 1898, amounted to $453,752, and for the fiscal year ending with June $4,618,683. The figures for May have previously been reported $461,758. Electrical machinery exports were: For June, $169,258; for the fiscal year, $2,052,564; for May, $180,494. Pumps and pumping machinery: For June, $187,998; for the year, $2,023,034; for May, $167,302. Shoe machinery: For June, $62,852; for the year, $895,788; for May, $110,662.

Exports of other lines of machinery which, having been separately classified for a longer time, permit of a more extended comparison, included: Locomotive engines for June, 1898, 49 in number, valued at $454,054; June, 1897, 19, at $166,483; May, 1898, 53, at $446,583; the fiscal year ending June, 1898, 468, at $3,883,719; fiscal year ending June, 1897, 338, at $3,225,831. The figures upon stationary engines were: For June, 1898, 43 in number, at $21,553; June 1897, 41, at $27,766; May, 1898, 47, at $21,559; fiscal year ending June, 1898, 565, at $398,570; fiscal year ending June, 1897, 423, at $323,438. Upon boilers and parts of engines they were: For June, 1898, $47,441; June, 1897, $36,481; May 1898, $153,641; fiscal year ending June, 1898, $927,552; fiscal year ending June, 1897, $671,901. Upon printing presses and parts thereof they were: For June, 1898, $56,497; June, 1897, $56,257; May, 1898, $55,073; fiscal year ending June, 1898, $874,515; fiscal year ending June, 1897, $649,710.

TOOLS WANTED BY THE GOVERNMENT.

Proposals will, until August 23, be received by the Bureau of Supplies and Accounts, Washington, to furnish for the navy yard, League Island, Pa., the following machinery: One horizontal bending rolls, one plate-planing machine, one garboard strake bending machine, one single punch, two combined punching and shearing machines, one horizontal punch and straightener, one 48-inch triple geared engine lathe, one 37-inch vertical boring and turning mill, one 1,500 pound steam drop hammer, one bar-iron single shearing machine, one double bolt cutter, two angle punches, one bolt heading machine, one horizontal boring machine, one improved combination saw and dado machine, two portable 10-inch deck planing machines, one single shear, four radial countersinking machines with radial arm, consisting of two channel beams projecting 15 feet 6 inches from upright; four portable drills, two top braced cranes, six self-contained cranes for punching and shearing machines, one bevel band sawing machine, one portable electrical drill, two horizontal tubular boilers with front and doors complete, one 100 horse-power, automatic, double valve, slow speed, cut-off engine; one duplex boiler feed pump, one closed feed water heater, one injector, boiler and engine foundations, one horizontal return tubular boiler.

The Bureau of Yards and Docks invites estimates on coal storage pockets or sheds and coal handling machinery, to be erected at the New London naval station. The appropriation available is $200,000. Bids will be opened August 31.

Capt. S. E. Blunt, commanding the Rock Island Navy Yard, asks for bids upon some ordnance supplies, including a lot of files. They will be opened August 31.

A certain typewriter company, in this city, is said to be so busy that it has had to refuse some Government orders.

PITTSBURG REPORT.

The most striking feature of the industrial trade is the large number of new concerns entering into business life and the extension and improvements of many who have fought the dull season and saved sufficient money to enable them to look farther into the future. In Pittsburg and vicinity many of the large concerns are contemplating the erecting of additions to their plants. One case is that of the Leechburg Foundry & Machine Company, which intends removing its mills from Leechburg to Homestead, where a plant for the manufacture of all

kinds of rolls, ingot molds, etc., will be built. It is also the intention to enter into the manufacture of cast iron and cast steel machine molded gears. A department for making steel castings will also be erected. The Monessen Foundry & Machine Company has started work on a new plant at Monessen, on the Monongahela River, for the manufacture of all kinds of tin plate machinery. A bronze foundry is being erected in Allegheny by Joshua Rhodes and a number of other capitalists.

The raw iron market continues in the same way as hitherto. The demand has not increased any, but there appears to be a better feeling among the manufacturers of pig iron, and this generally leads on to a slightly firmer rate for the material. Several of the manufacturers express the belief that just as soon as the war is definitely settled and peace terms made known business will take on a degree of activity that will be most surprising. In Pittsburg the Valley manufacturers asked $10.50 for Bessemer, but finding they could sell little at that figure shaded the price, and now demand $10 @$10.25 for several months' future delivery. Foundry irons are keeping rather quiet, but it is expected that concessions in some line or other will be made soon, and the market will then take on a more lively appearance. Prices of foundry iron have not changed for some time.

Heavy makers of rolling mill machinery are kept fairly well employed. The Totten & Hogg Iron & Steel Foundry Company, of Pittsburg, has closed contracts for equipping the enlarged plants of the Humbert Tin Plate Company, Connellsville, Pa., and the Monongahela Tin Plate Company, Pittsburg. Bids will probably be soon asked for erecting the plant of the Burgess Steel & Iron Company, Portsmouth, Ohio, and the new works of the Leechburg Foundry & Machine Company, Pittsburg. The Lewis Foundry & Machine Company, of this city, has had a steady flow of business, and has its plant running regularly.

In the general mill supply trade most houses are doing a fairly active trade. The summer shut-down season is gradually coming to a close and mills are being repaired as rapidly as possible.

CHICAGO MACHINERY MARKET.

One of the changing conditions, which is regarded as quite encouraging, is the disposition of the better class of jobbing machine shops to buy tools. For four years the purchases of these shops have consisted mainly of small tools. They are now beginning to invest in the larger machines. This buying movement has not become influential. It is only in its beginnings. But the shops now have about all the work they can do with present facilities, and any added business must bring them into the market for machinery. Activity at the large agricultural implement, railroad and other shops had been so slack for several years that these plants did their own repair work. Now that they are compelled to run overtime to fill engagements the repair work has been forced out among the jobbing shops.

Quite a little spurt of activity has been witnessed for a few days among the copper ore industries of Northern Michigan and Wisconsin. There has been much prospecting for some time in consequence of the brisk demand for copper and the continued high price for that metal. That production will now be more extended is indicated by the buying of boilers, engines and machinery for that region.

There were inquiries here recently for wood-working machinery for shipment to Cuba and Porto Rico, and some modest purchases have been made. The buyers are the representatives of foreign houses, who are looking for the rapid development of the magnificent and untouched forests which cover a large portion of Cuba, on account of the progressive methods which, it is believed, will be instituted under an American protectorate.

It is expected that the Government arsenal at Rock Island, Ill., will this week purchase lathes, drills and other tools to the extent of about $30,000. Bids for these tools were opened two weeks ago.

The machinery market in the aggregate has been fairly active during the week. Some large wood-working machines have been sold to car works, but the lumber interests generally are buying only moderately.

Iron is in good demand and prices here are firmer. The seasonable check to trade is felt, but nevertheless there is an undercurrent of strength that is making its presence known by the gradually hardening prices. There have been purchases of six or seven thousand freight cars here during the week, and mills are generally so well favored with orders that they are more conservative in accepting obligations for the future. There are rumors of the establishment here of large steel works in competition with the present plants, but the rumors lack confirmation.

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Quotations.

NEW YORK, Monday, August 8.

Iron—American pig, tidewater delivery:	
No. 1 foundry, Northern	$11 00 @ 11 25
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 50 @ 10 75
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05 @ 1.10c.; refined, 1.10 @

Continued on page 38.

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Foreman patternmaker, draftsman; A1 on fine work; good reference. Box 181, AMERICAN MACHINIST.

A position wanted as superintendent of machine shop, by a first-class mechanical engineer; best references. Address Box 175, AMERICAN MACHINIST.

Wanted—Position of trust, by a machinist capable and worthy of it; toolmaking, experimental or special work. Address Box 176, AMERICAN MACHINIST.

Wanted—Mech. position in charge of manufacture of small machy. or general repair work; accustomed to management of men; best of refs. Box 174. AM. MA.

Skilled toolmaker and draftsman wants change; has built guns, sewing machines, typewriters and special machinery; also tools and gages for interchangeability. Box 178. AMERICAN MACHINIST.

Practical draftsman desires change in New York City; twelve yrs.' experience in shop and draw'g-room; moderate sal'y accepted where diligence for 7 or 8 hrs. per day would be appreciated. Box 179, AM. MACH.

Reputable business man, present occupation mechanical draftsman, familiar with English, Dutch, French and German, wishes to represent first-class firm abroad; highest references. Box 177, AM. MACH.

A young man (30) experienced in designing, manufacturing and selling high-speed engines and other machinery, desires engagement either as designer, purchasing agent, office man, assistant manager, draftsman, or in branch office; water location preferred; object permanency; first-class references. Address Engine, care Gen. Delivery, Mt. Vernon, O.

Help Wanted.

Wanted—First-class designer and draftsman on special machinery and sheet metal tools. Address Box 172, AMERICAN MACHINIST.

Wanted by Detroit company, up to-date machinist, with prospects of advancement and taking charge if capable. Box 167, AMERICAN MACHINIST.

Wanted—Ten competent all round machinists; only first-class men wanted; experienced in dynamo work preferred. The Bullock Elec. Mfg. Co., Cincinnati, O.

Wanted—Two first-class draftsmen for designing automatic shoe machinery; none but first-class men need apply; personal application desired. McKay Metallic Fastening Association, Winchester, Mass.

Wanted—Foreman for machine shop of large electrical establishment; one having held similar position before preferred; in answer state experience, wages required, &c. Address Box No. 152, AM. MACHINIST.

Wanted—A concern manufacturing high grade machine tools wants a superintendent who is thoroughly familiar with modern practice and able to produce first-class work at low cost; preference will be given a man who has held similar positions; a good opportunity for the right man; none but strictly first-class men need apply. Address with terms, experience, age, references, &c., Box 180, AMERICAN MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Best Calipers, Levels, etc. E. G. Smith, Columbia, Pa.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

Wanted—1 20 foot pit lathe. Address Box 156, AMERICAN MACHINIST.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Quotations continued from page 37.

1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 5 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.40 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.05 @ 2.10c., according to quantity.

Copper—Carload lots: Lake superior ingot, 11⅜ @ 11½c.; electrolytic, 11¼ @ 11½c.; casting copper, 11⅛ @ 11¼c. for ordinary brands.

Pig Lead—Carload lots, 4.00c, f. o. b., New York.

Pig Tin—For 5 and 10 ton lots, 16.00 @ 16.10c., f. o. b.

Spelter—Carload lots, 4.45 @ 4.55c., New York delivery, for common brands.

Antimony—In cask lots, 8¾ @ 9⅝c., according to brand.

Lard Oil—Prime city, ice pressed, 47 @ 49c., in wholesale lots.

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Manufacturers.

Contractor Treffinger has been awarded the contract for Chapman's mill, at Pine Run, Pa.

The plant of the St. Joseph Plow Company, St. Joseph, Mo., is to be considerably enlarged.

Recently fire damaged to the amount of $10,000 the works of the Reading (Pa.) Tin Plate Company.

Wolff & Reessing are building an addition to their factory at Eastport, Me. The addition will be 34x72 feet.

The Gisholt Machine Company, Madison, Wis., owing to increase of business is about to erect a new factory.

A new addition, 70x61 feet, three stories high, is to be built to the Astoronga Mill, Little Falls, N. Y. Thompson & Scullen have the contract.

Work has been commenced on the new addition to the J. A. Schwab factory, Moundsville, W. Va. It is to be a three story structure.

The Brunnerville Agricultural Works, near Lititz, Pa., was destroyed by fire recently, together with all the machinery and many valuable patterns.

A three story planing mill, 50x54 feet, will be built at 2923 and 2925 North Broad street, Philadelphia, Pa. The plans for the work have been filed by J. W. Christman.

The addition to the Clinton (Ia.) Bridge & Iron Works shops is now nearly completed, and it is understood they will soon employ some twenty-five or thirty more men.

The flouring mill of Shambaugh & Son, at Shambaugh, Page County, Neb., was recently burned, supposedly from lightning. Estimated loss, $17,000. The mill will probably be rebuilt.

Work has been started on an addition to the finishing department of the Nashawannuck Manufacturing Company, Easthampton, Mass., to be 32x62 feet, for which new machinery will be required.

The stockholders of the Clover Cotton Manufacturing Company, of Clover, S. C., held their annual meeting recently. A dividend of 25 per cent. was declared; half to be a cash dividend and half a dividend for improvements.

James H. Haskins has designed for the McCormick Harvesting Machinery Company, Chicago, Ill., an additional story to one of the main buildings, extending over an area of 83x645 feet. It will be of brick, and will cost $18,000.

Work will be commenced soon on the Janney Manufacturing Company's plant, Ottumwa, Ia., for the manufacture of corn planters and other agricultural implements. The company was incorporated with a capital stock of $125,000.

Plans for the new factory to be built for the George E. Tuckett & Sons Company, on Queen street, North, Hamilton, Ont., have been prepared by Architect Wilton. The building

Miscellaneous Wants—Cont'd.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Die makers, special mach'y and spec'lt'es wanted for manufacture. Bown Mach Works, Battle Creek, Mich.

Wanted—Manufacturer to build gas and gasoline engine, of simple design and effective in its work. Box 158, AMERICAN MACHINIST.

The advertising department of the American Machinist has on hand 20,000 draftsm'n's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

For Sale—On account of death, 15 horse-power engine, 20 horse-power boiler, in good condition; 20 feet of 2-inch line shaft, pulleys, hangers; one granite polishing machine; one drill machine for iron, very cheap. A. Durkes, 652 Lewis street, Union Hill, N. J.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

Excellent opportunity to establish a branch factory in the most industrial part of Germany is offered American mfrs. of cycles, sewing machines, machine tools or similar articles, by an active and intelligent German business man with sufficient pecuniary means at his disposal. Applications will be duly forwarded by Wm. Essenwein, Rosenstrasse 8, Dusseldorf, Germany.

WANTED.

Two horizontal boring machines to be used for boring cylinder liners of gas and oil engines, from 6 to 18 inches diameter and 4 feet long. These tools must be of the latest and most modern design for handling work quickly; one man is expected to work both machines.

A Duplex boring machine with independent motions to bars and tables would be favorably considered. The machines would be inspected before being shipped; quick delivery is important. Send illustrations or drawings with lowest prices f. o. b. ship New York, to

The Campbell Gas Engine Co., Ltd, Halifax, England.

FOR SALE.

One Worthington horizontal compound tank Pumping Engine; size 14½ in. x 30 in. x 11 in. x 18⅛ in.

Two Worthington horizontal high pressure duplex Pumping Engines; sizes 16 in. x 14 in. x 10 in. and 12 in. x 10¼ in. x 10 in.

Also one 48 in. horizontal boiler 12 ft. long, with fittings and feed pump.

All in good condition. Can be seen at

Cor. of Perkins and Chestnut Sts.,
Jamaica Park, Jamaica Plain,
BOSTON, MASS.

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Write for . . . .

ENGINE LATHES,
IRON PLANERS,
DRILL PRESSES.

New, also nearly good as new.
All sizes, immediate delivery.

New Haven Manufacturing Co.,
Manufacturers,
NEW HAVEN. CONN.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 120 gals. per day. Used in 18 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U. S. A.

Business Established 8 Years.

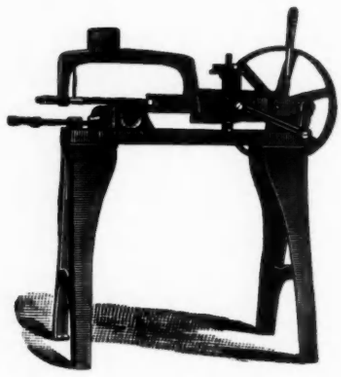
Largest Manufacturers of Oil Filters in the World.

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



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Price—'Way Down.
Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,

For All Purposes.

Send for Catalogue.

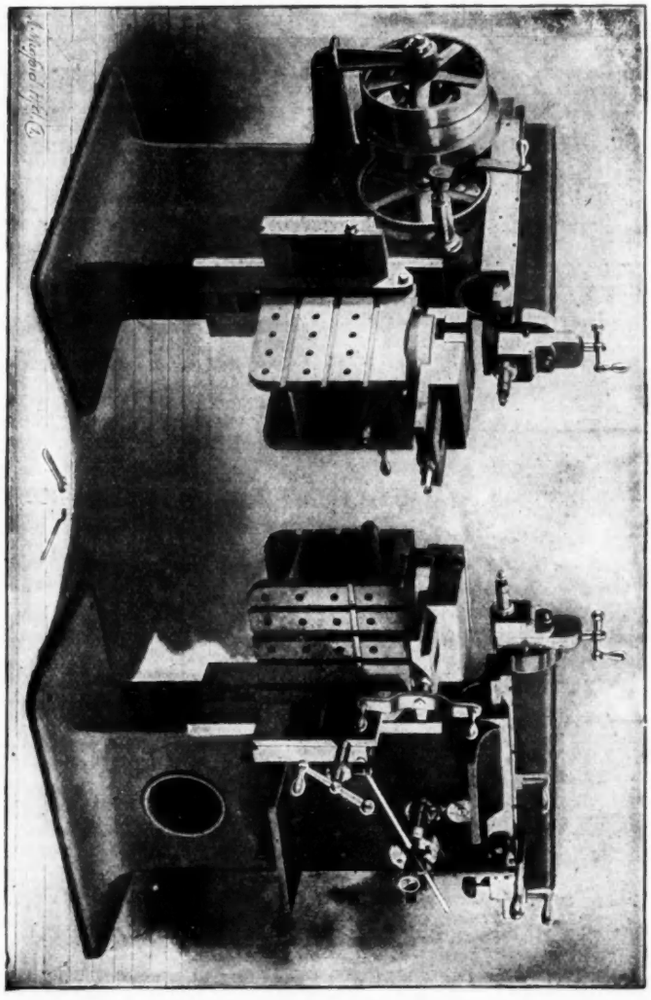
Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

15-inch Pillar Shaper.

A FRICTION driven machine, fitted with a positive locking device for friction, insuring a uniform length of stroke under a heavy cut. Stroke can be changed to any position with ram in motion; has quick return; and our micrometer adjustment makes possible the most minute variation in length of stroke, which can be constantly varied with machine in motion; an especially valuable feature in tool and die work and in planing to irregular lines.



THE HENDEY MACHINE CO.,

Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:

PACIFIC TOOL AND SUPPLY CO., ... San Francisco, Cal.
J. W. CREGAR, ... Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:

SCHUCHARDT & SCHUTTE, Berlin, Vienna, Brussels, Stockholm.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
ADOLPHE JANSSENS, ... Paris, France.

will be a three story brick, and in it tobacco will be manufactured.

A permit has been issued by City Clerk McCulloch to the New Albany (Ind.) Box & Basket Company for the erection of a brick building on Rear Market street. The building is to cost $4,000, and work on it has already begun.

A white lead factory will shortly be added to Denver's (Col.) list of manufacturing industries. The Denver White Lead Company has been incorporated by Willard Teller, Dr. J. Sol Smith and J. M. Jackson, with a capitalization of $150,000.

Work was recently begun on the $10,000 addition to Loose Brothers' cracker factory, Kansas City, Mo. The additional room thus provided will be utilized for more machinery, and the capacity of the plant will be increased about 20 per cent.

Contractor Samuel B. MacDowell is finishing plans for the third and last of the buildings to replace the old structures recently destroyed by fire at Thomas Potter, Sons & Co.'s oil cloth works at Second street and Erie avenue, Philadelphia, Pa. It will be five stories high and measure 50x170 feet.

The main building of the Farrandsville Firebrick Works, Lock Haven, Pa., owned by Fredericks, Munroe & Co., has been totally destroyed by fire. The building was a frame structure, 220x70 feet, and contained valuable machinery. It will be rebuilt at once. The loss is estimated at $40,000.

The Ice Manufacturing Company, of Walnut lane, Germantown, Pa., is to extend its plant there by erecting a three-story and basement brick and iron addition. Plans are being made and will call for face brick front with iron framing, and owners intend installing latest improved machinery, etc. A description of the same will be given later.

The projectors of the Nantucket Cotton Mills, of Spray, N. C., are now at work on the erection of the buildings to accommodate their machinery. This company was incorporated several months ago, with a capital stock of $250,000. The building being erected will be three stories high, 265x75 feet, but at the start will be only partially filled with machinery.

The Guggenheim Smelting Company is making extensive additions to its refining plant at Perth Amboy, N. J. The buildings it is putting up will be fireproof throughout, being constructed of steel framework covered with corrugated iron. The contract for furnishing and erecting these buildings has been let to the Berlin Iron Bridge Company, of East Berlin, Conn.

The Excelsior Compressor Company had its articles of incorporation recorded recently. Its objects are to manufacture, sell and lease air compressing machines. The capital stock is $100,000, all of which is paid up, and the principal office of the company will be in Newark, N. J. The incorporators are William Hull, of Short Hills, and Irving G. Hopper, William Meeske and Philip Cramer, of Newark.

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New Catalogs.

There are three sizes of Standard Catalogs' first authorized by the Master Car Builders, Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from Hans Renold, Manchester, England, Nos. 1, 4, 5, 6, 7 and 12 of sectional catalog, taking up the illustration and description of various forms of chains, including cycle roller chains, cycle block chains, high speed driving chains, stud chains, etc. Each of the catalog sections are standard size, 6x9 inches.

We have received from the Mechanical Tire Company, Westfield, Mass., catalog illustrating and describing the "Mechanical Tire," in which

is secured the easy running qualities of the pneumatic tire by mechanical means, thereby avoiding the possibility of failure owing to punctured or leaking tires. The catalog is 6x8 inches.

The Chicago Pneumatic Tool Company, Chicago, has sent us a copy of its special edition catalog, in which is described its exhibit of pneumatic hammers, drills, riveters and other tools operated by compressed air, at the Saratoga convention of the Master Car Builders and Master Mechanics. The catalog is standard size, 6x9 inches.

We have received from the Ingersoll-Sergeant Drill Company, New York, air compressor catalog No. 32, in which is illustrated and described air compressors for various services. The catalog contains a number of useful tables likely to interest those engaged in the compression and transmission of compressed air. The catalog is standard size, 6x9 inches.

The Hibbard & Rodman Safe Company, New York, has issued a catalog in which is described the construction and method of operation of manganese steel safes, the hardness of which steel enables it to resist to a somewhat remarkable degree the effect of high explosives. A report of a recent test of this safe is presented in the catalog. The catalog is 5¾x9 inches.

We have received from J. E. Reinecker, Chemnitz-Gablenz, Germany, catalog of milling machines, horizontal and vertical, and grinding machinery. Accompanying it is a catalog of machinists' tools, including stocks and dies, taps, tool-holders, reamers, pipe cutters and various other appliances. Both catalogs are tastefully gotten up and contain 136 and 148 pages, respectively.

We have received from the Joseph Dixon Crucible Company, Jersey City, N. J., copy of the sixth edition of their pamphlet "Graphite as a Lubricant," in which is practically considered the merits of graphite as a substitute for oil. Brief summaries of tests are given, together with the opinions of eminent engineers on the advantages of graphite. The pamphlet is 5¼x6¾ inches, and will be sent to anyone interested upon application.

We have received from the Denver Engineering Company, Denver, Col., catalog No. 6 of electric and steam hoisting plants. Some useful tables of strength of various kinds of hoisting rope, strains on same, etc., are presented, and which are calculated to be of considerable service to those who have to do with hoisting operations. The catalog contains illustrations of various forms of these hoisting engines. The catalog is 6x9¼ inches.

Ernest Scott & Mountain, Ltd., Newcastle-on-Tyne, England, has sent us copy of their illustrated catalog of electrical machinery, including high speed steam engines, motors for various purposes, auxiliary machinery for steamships, &c. The catalog is divided into sections and contains blank pages for memoranda. A large amount of information likely to be useful to engineers, designers and manufacturers is given in the catalog. It is bound in cloth and contains about 360 pages.

We have received from W. B. Mershon & Co., of Saginaw, E. S., Mich., copy of the third edition of "Handbook of Resaws." The book is a combination of descriptive matter relating to the product of the above mentioned firm and a treatise on the use and care of resaw blades. To those interested in saw-mill machinery the information will be found useful. A number of tables are given, such as the approximate strains upon saw blades under given conditions. The catalog contains 79 pages, and is 5¼x7¾ inches.

We have received from the Ajax Manufacturing Company, Cleveland, Ohio, copy of the Ajax Blue Book, in which is illustrated and described the Blakeslee bolt headers, rivet headers, forming machines and other nut and bolt machinery. There are also presented sketches of specimens of forgings made by the above-mentioned machines. A number of very useful tables are given, together with a number of pages of cross section paper for sketching purposes. The catalog contains 114 4½x7¼ pages, and is bound in cloth.

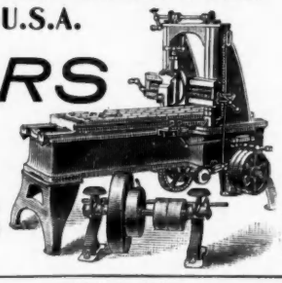
THE PRATT & WHITNEY COMPANY
Hartford, Conn., U.S.A.

PLANERS

To plane 16 in. x 16 in. x 3 ft. to 40 in. x 40 in. x 20 ft. with quick return motion.

PILLAR SHAPERS

With 9 and 14 in. stroke.



SHAPING MACHINES

With 12 in. and 14 in. stroke, all feeds automatic.

Ask for Machinists' Catalog.

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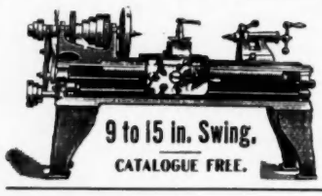
CHICAGO—42 South Clinton Street.
LONDON, ENG.—Buck & Hickman, 280 Whitechapel Road.
PARIS, FRANCE—Fenwick Freres & Co., 21 Rue Martel.



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IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U. S. A.
Agents: SELIG, SONNENTHAL & Co., London, Eng.; JOHN TRAGARDH & Co., Goteborg, Sweden; E. SONNENTHAL, Jr., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

Books for Foundrymen:

Bolland—"THE IRON FOUNDER," - - - - $2.50
Bolland—"THE IRON FOUNDER SUPPLEMENT," 2.50
West—"AMERICAN FOUNDRY PRACTICE," - 2.50
West—"MOULDERS' TEXT BOOK," - - 2.50
Dingey—"MACHINERY PATTERN MAKING," - 2.50

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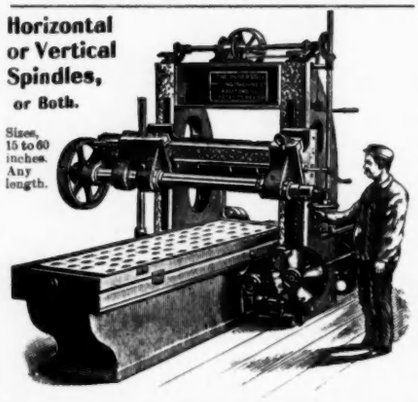

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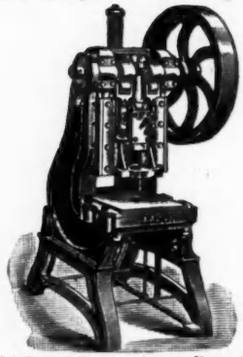

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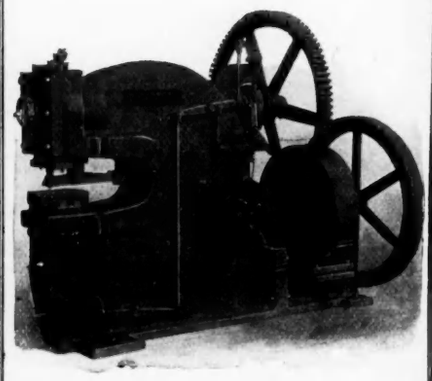

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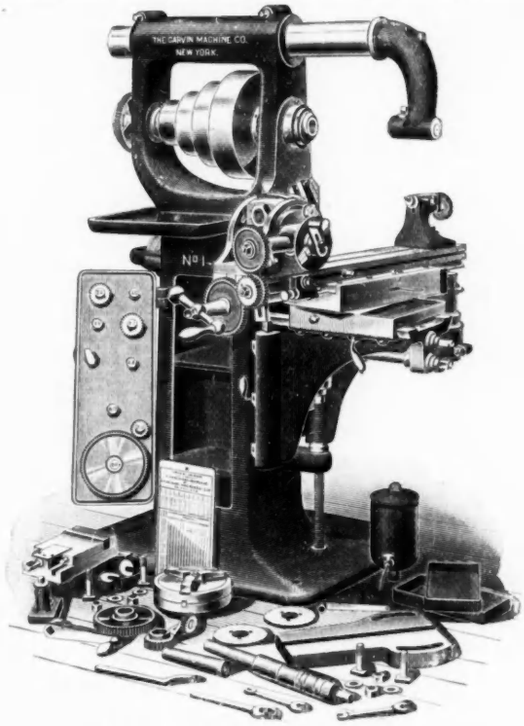

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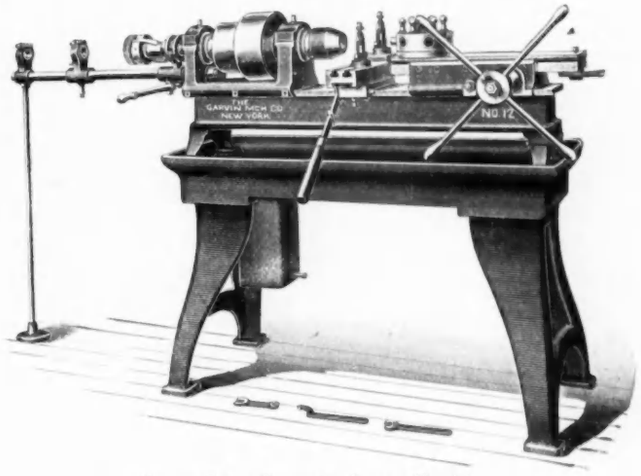

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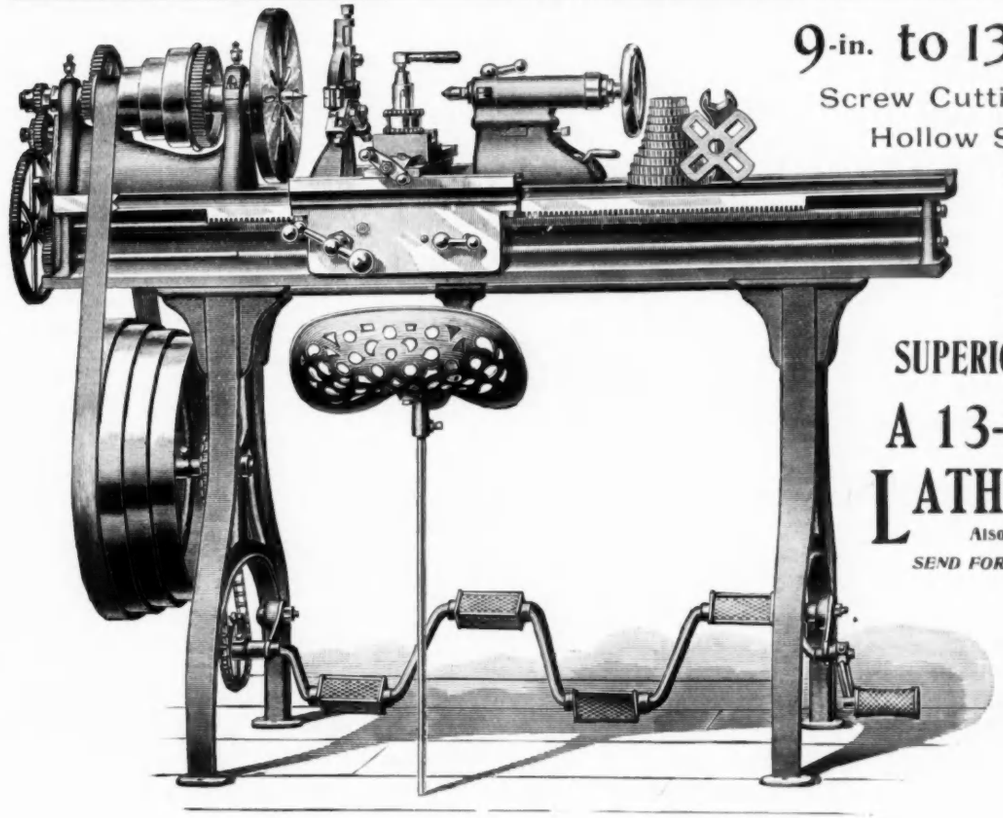

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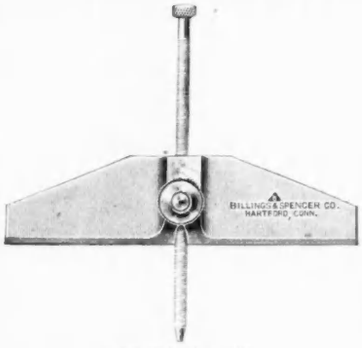

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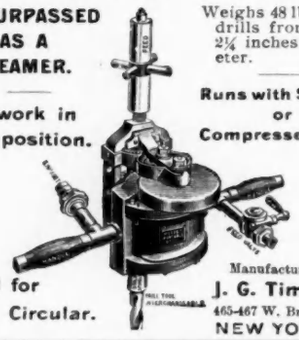

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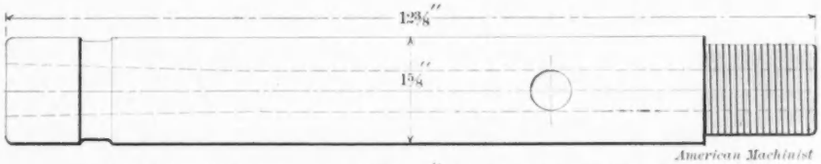

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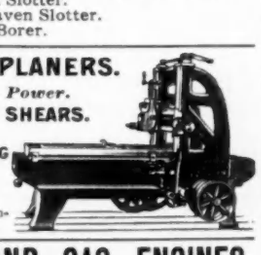

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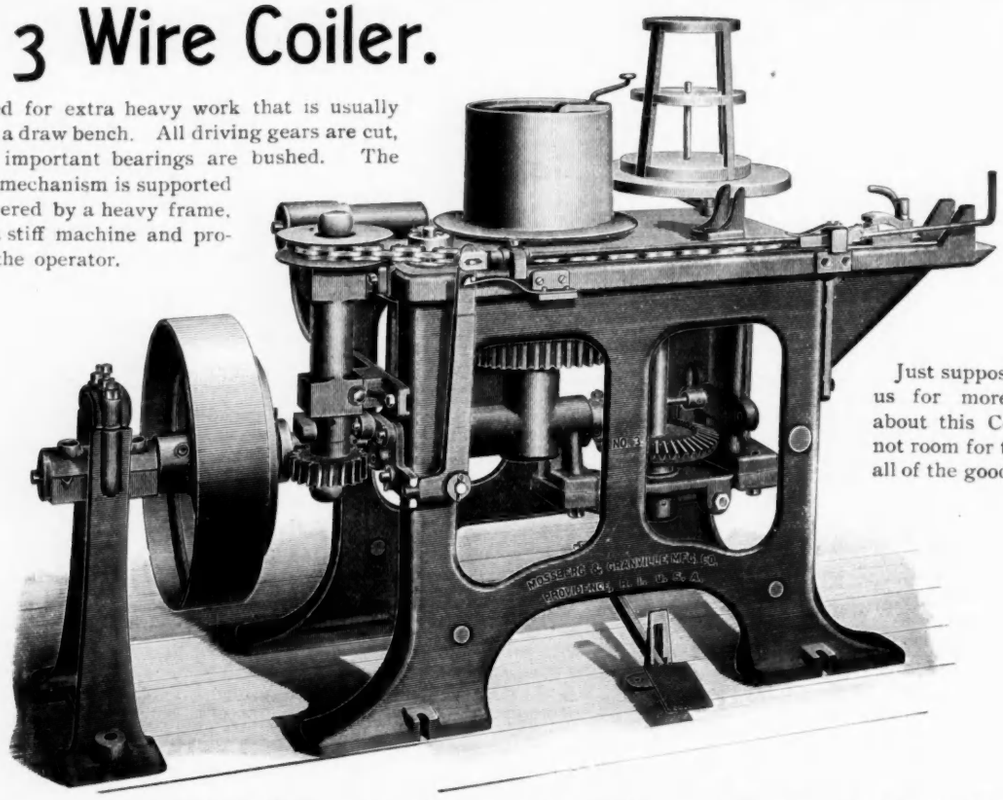

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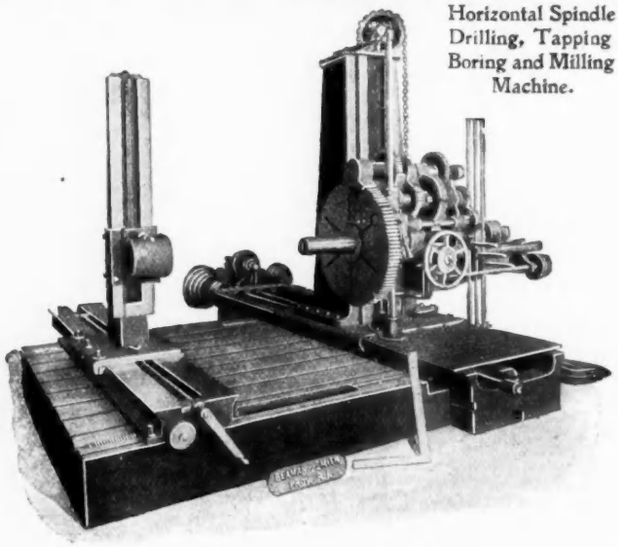

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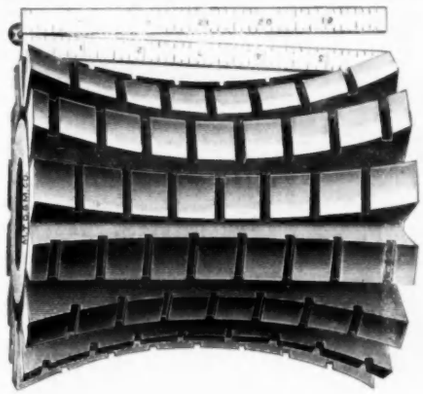

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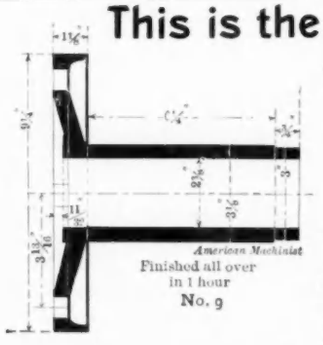

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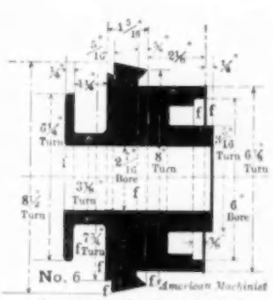

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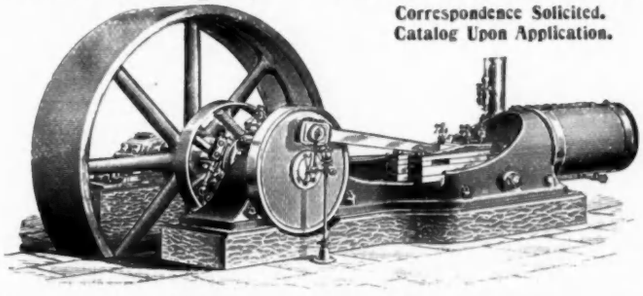

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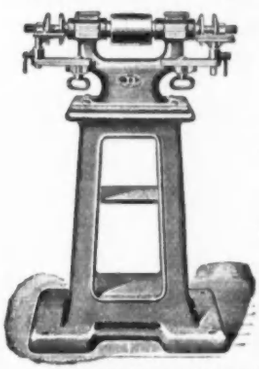

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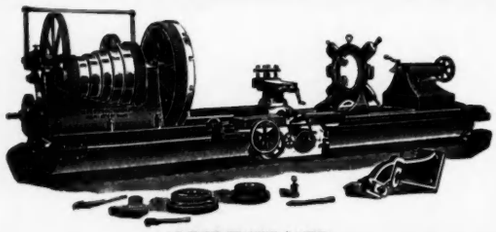

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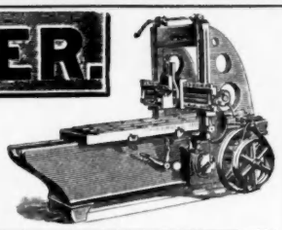

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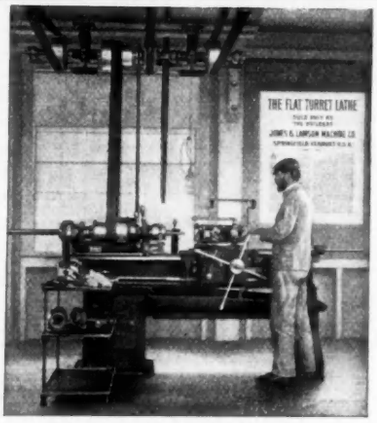

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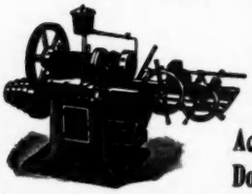

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